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PRIMARY CARCINOMA OF THE LUNG

SURGICAL EXTIRPATION

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THE choice of treatment for a malignant lesion anywhere in the body lies between surgical removal and one of the various forms of irradiation. The two dominating factors involved, then, are a consideration of the accessibility of the lesion from the standpoint of its complete removal and its response to irradiation. Primary carcinoma of the lung presents one of the most discouraging of any of the problems of malignant disease. The resistance of primary lung cancer to the various forms of irradiation is well known. Manges[1] has reported temporary clinical improvement in most cases following deep *x*-ray therapy with, in many, a subsequent rapid progress of the disease. Edwards[2] feels that irradiation therapy and the use of the radium pack are unsatisfactory in the treatment of carcinoma of the lung originating in the bronchus. Dorendorf[3] in a recent paper on primary lung cancer admits that radiation is limited to the palliative relief of symptoms only. In the Lahey Clinic we have also failed to convince ourselves that the patients were benefited by deep roentgen-ray therapy.

Because of the discouraging results of irradiation in cancer in this location, there is all the more of a challenge to modern surgery. Until revolutionary discoveries are made concerning the cause and the specific cure of malignant disease, we must look to surgical extirpation of the pulmonary lesion as the most promising way to obtain a permanent cure. It is reasonable to assume that, in the future, many cases will be diagnosed at a time when the lesion is still a local affair in one of the pulmonary lobes. The earlier and more frequent use of chest roentgenograms, the increasing accuracy in their interpretation, together with the cooperation of the bronchoscopists will find in the future more cases for the consideration of surgical removal.

The work of Brunn[4] and Shenstone[5] has shown us that pulmonary lobectomy for bronchiectasis does not carry a prohibitive operative mortality. The technique of lobectomy for malignancy is identical with that for bronchiectasis with, perhaps, one added danger and with one less serious condition present. The fact that the operation for malignancy has to be carried out on older subjects increases the risk and would make the intrathoracic adjustment following the removal of one lobe less easily made. The question of a spread of an infection to other parts of the lung or pleura, however, is less likely in the malignant case than in those operated upon for bronchiectasis.

The position of the growth determines, for the most part, the symptoms caused by such lesions. Unfortunately, it is possible for growths to be situated so that no apparent disturbance results. If the lesion is growing well out from the hilum, it may assume a fairly large size before any

symptoms are provoked. A lesion beginning in one of the larger bronchi or outside of them near the hilum will initiate the cough reflex. Partial obstruction in one of the larger bronchi may cause a wheezing type of respiration. In Jackson's[6] series the two most common symptoms were the insidious onset of cough and a wheezing type of respiration. If the mucosa of the bronchus becomes eroded, hemoptysis will be a symptom. With a superimposed infection the cough may be productive of purulent material. A breaking-down of tissue in the diseased area would also alter the character of the sputum. Chest pain may be a symptom. It is frequent in the more centrally located lesions or hilar type. The location and character of the pain depends upon the location and extent of the lesion. Often the infiltration in the mediastinum extends back to involve the intercostal nerves. The same intercostal neuritis may be caused by a peripherally located lesion with pleural involvement. Occasionally the picture is altered by a complicating pleural effusion or empyema.

In the roentgen-ray film the early lesion usually appears as a rounded dense shadow. The frequent involvement of variable amounts of lung tissue in atelectasis alters the roentgen picture greatly. The *x*-ray opacity and the amount of displacement of organs is often entirely out of proportion to the size of the neoplasm. In Manges'[1] series of 36 cases selected for roentgenological description, the outline of the tumor was sharp in 23 and irregular in 13. Twenty-six showed evidence of displacement of the heart toward the side of the lesion. Kerley[7] states that the opacity is more dense near the root of the lung and diminishes toward the periphery. These two shadows represent growth near the hilus and collapse in the periphery of the lobe. He also states that if the vascular markings of the lung are invisible in the light of the peripheral opacity and visible in the dense opacity near the root, one can diagnose carcinoma with certainty, for there is no other pneumonic process that produces this dual effect.

Enlarged mediastinal glands, pleural effusion, and infection alter the roentgenographic appearance greatly. In late stages there may be phrenic nerve involvement with diaphragmatic paralysis. However, our attention should be concentrated upon the differentiation of early malignancy from tuberculosis or inflammatory lesions in order to increase the number of cases in which excision can be considered. At times it is possible for the bronchoscopist to tell from the gross appearance of the involved bronchus, providing he is able to visualize it, whether or not malignancy is present. He is often able to obtain a specimen of tissue for histologic examination. This, of course, is desirable as it establishes the diagnosis beyond any question. A negative biopsy, however, does not rule out the presence of malignancy as it is too frequently the case that normal bronchial mucosa is removed and it is impossible to get deep enough in the lesion to remove cancer cells.

During the past year, a patient presented himself for examination at the Clinic who illustrates many of the problems which are coming up in regard to the management of lung carcinoma.

Mr. C. S., aged fifty-nine, a minister, came to the Clinic in April, 1932, because of pain and soreness low in the right axilla in the region of the seventh and eighth intercostal nerves. A year previously he had had an attack of pleurisy in the same area, lasting only a few days. There was a second attack the next fall which lasted a week. Since the second attack of sharp pain, there had been a residual soreness which was most noticeable upon talking, coughing or changing position. There were no gastrointestinal symptoms but because of the location of the pain and its persistence, he had been advised elsewhere to have his gall bladder removed. The past medical and family histories were not important. Physical examination revealed a small, poorly nourished man. The blood pressure was 105/70. The pulse was regular and of good volume. There was nothing remarkable about the examination of the head,

neck and heart. The right chest lagged in its expansion and the percussion note was impaired over the right posterior aspect of the chest and in the right axilla. The breath sounds were diminished over the entire right lower lobe. Rales were not elicited. An *x*-ray and fluoroscopy of the chest showed a rounded, dense shadow behind the right heart border which extended out to the mid-portion of the diaphragm and as high as the eighth interspace posteriorly. The diaphragm moved well on the right and the lung seemed to slide over the tumor which seemed to be fixed in the mediastinum to the vertebral column, but not attached to the heart. There were no evidences of metastasis by *x*-ray or upon physical examination. (See Fig. 1.) A pneumothorax was attempted but pleural adhesions were found in each area into which the needle was inserted. A diagnosis of posterior mediastinal tumor was made. A series of intensive deep *x*-ray treatments were administered over a period of three weeks. No change in the size of the tumor at the end of this time was noted.

Operation: An exploratory thoracotomy was advised and carried out on April 27, 1932. Intratracheal nitrous oxide anesthesia was administered by Dr. L. F. Sise. A constant venoclysis of 5 per cent glucose was started, using the saphenous vein above the ankle. This was done in order to control the circulation throughout the period of operation. With the patient on the left side, an incision was made along the course of the ninth rib from the vertebral border to the mid-clavicular line. The ninth rib was then excised subperiosteally. The seventh, eighth, and tenth ribs were divided posteriorly and the intervening intracostal bundles sutured and cut. The chest was opened by incising the periosteum of the ninth rib. The right lower pulmonary lobe was adherent to the parietal pleura and entirely covered the site of the opening. Carefully, the pleural adhesions were separated until the entire lobe was freed laterally and from the diaphragm. Within the substance of the lung a tumor could be palpated which was about the size of a grapefruit. (See Fig. 2.) It seemed to be fixed to the posterior mediastinum and vertebral column. The lower border of the lung and growth were separated from the diaphragm as far as the pericardium. The dissection was then carried posteriorly, and in an attempt to free the posterior border of the tumor, the mass was broken into and several ounces of necrotic tumor tissue removed by aspiration. It was then found that the tumor had infiltrated the posterior mediastinum and the pericardium and that complete removal was impossible. It was decided that the removal of as much of the tumor tissue as possible would give the patient the longest time to live. Clamps were then applied to the lower lobe about 1½ inches from the hilum. The remainder of the right lower lobe, together with the shell of tumor, was removed. The small portion of the tumor remaining was that portion which had invaded the posterior mediastinum and pericardium. Interrupted mattress sutures were used to close the stump of the right lower lobe. (See Fig. 3.) The pleural cavity was washed out with normal saline solution and a catheter inserted and carried out the anterior angle of the wound. The wound was then approximated by suture of the periosteum of the resected ninth rib and the use of interrupted silk in the skin flap. The draining catheter was connected with a tube and this placed under water in a drainage bottle. The patient's condition throughout this entire procedure was very satisfactory. There was a

Fig. 1. Roentgenogram of chest before operation showing dense rounded shadow at right base extending well out toward periphery from central position. Lateral and oblique exposures demonstrated posterior position for lesion. Note narrowness of upper mediastinum and absence of enlarged glands in hilar region.

general rise in blood pressure from 90/70 and throughout most of the operation the blood pressure ranged between 100 and 120. At the conclusion, the blood pressure was 95/60. The pulse rate started at 104 and ended at 122. The respiratory rate went up from 18 to 32. The anesthesia chart is shown in Figure 4.

The *gross specimen* removed at operation consisted of fragments of the wall of the tumor with the major portion of the right lower pulmonary lobe. Upon histologic examination of the section, widespread necrosis could be seen throughout. There was a moderate amount of stroma present. The cancer cells themselves showed marked keratinization. Mitosis was rare. There was a high nucleocytoplasmic ratio. There was invasion into the blood vessels and lymphatic vessels with thrombosis and infarction. From the histological examination, Dr. Shields Warren considered the lesion to be an epidermoid carcinoma Grade 2, probably of bronchiogenic origin. (See Fig. 5.)

Course: The patient's convalescence was satisfactory and there were no complications. The wound drained a moderate amount of bloody serous material for several days. A bronchial fistula did not develop, however. The patient left the hospital on the seventeenth

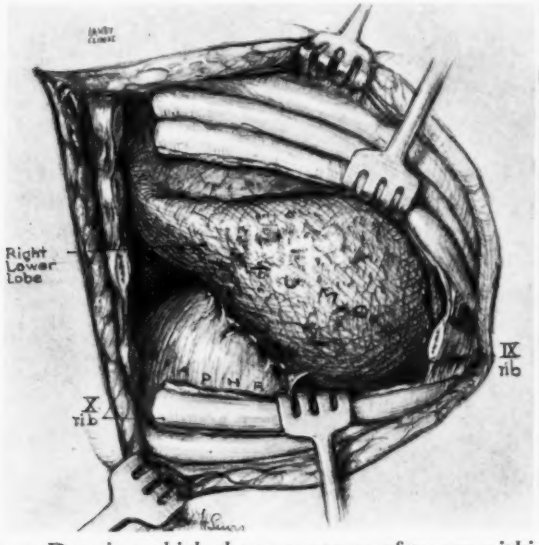

FIG. 2. Drawing which shows exposure of tumor within right lower lobe. Ninth rib was resected and seventh, eighth, and tenth ribs were divided posteriorly.

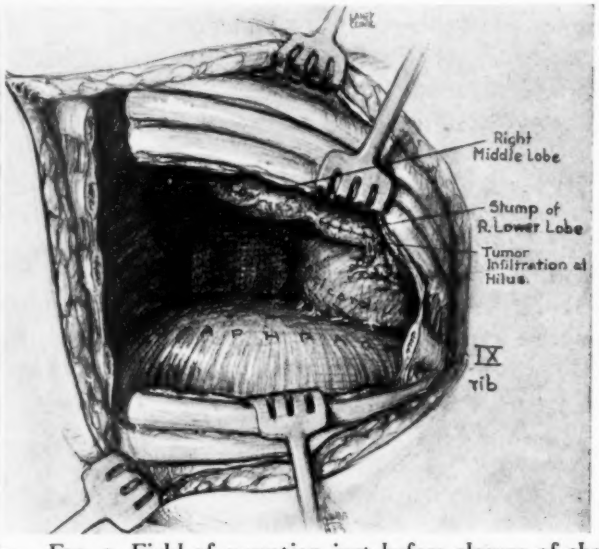

FIG. 3. Field of operation just before closure of chest. Lower lobe and tumor have been removed. Extension of tumor was found in mediastinum. Catheter was inserted before closure to provide air-tight drainage.

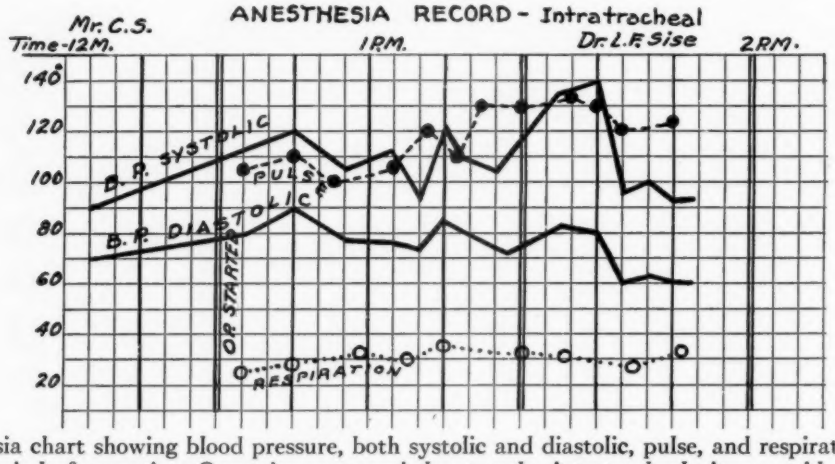

FIG. 4. Anesthesia chart showing blood pressure, both systolic and diastolic, pulse, and respiratory rate recorded throughout period of operation. Operation was carried out under intratracheal nitrous oxide anesthesia. Note that blood pressure was well sustained throughout.

day after operation. Photographs of the patient taken at this time are shown in Figure 6. After the patient's discharge, the wound continued to drain for a period of three months and then closed. The patient was given an intensive series of deep roentgen-ray treatments in an effort to retard the growth of the portion of the tumor which we were unable to remove at the time of operation. A roentgenogram of the chest at the time of discharge from the hospital showed an extensive area of cloudiness at the right base which cleared up greatly for a period of five months and the upper and middle lobes expanded to fill up the right hemithorax. (See Fig. 7.) From this time on the shadow at the base changed but little. The patient's general condition remained stationary. He failed to gain weight but was free of pain. His only symptoms were a dry cough and weakness. He was able to be up and about each day but was unable to return to his pastorate. Ten months after the operation, while eating a hearty breakfast, the patient died suddenly at the breakfast table. An autopsy was not obtained.

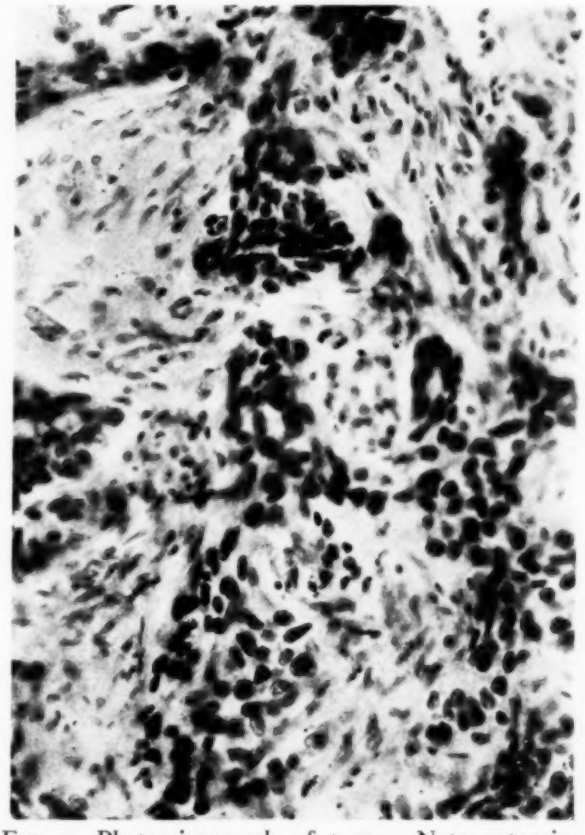

Fig. 5. Photomicrograph of tumor. Note extensive areas of necrosis. Many cells show marked keratinization. Mitosis is rare. There is a moderate amount of stroma. Microscopic diagnosis: Bronchiogenic epidermoid carcinoma.

Fig. 6. Anterior and posterior photograph of patient as he appeared upon discharge from hospital on seventeenth day after operation.

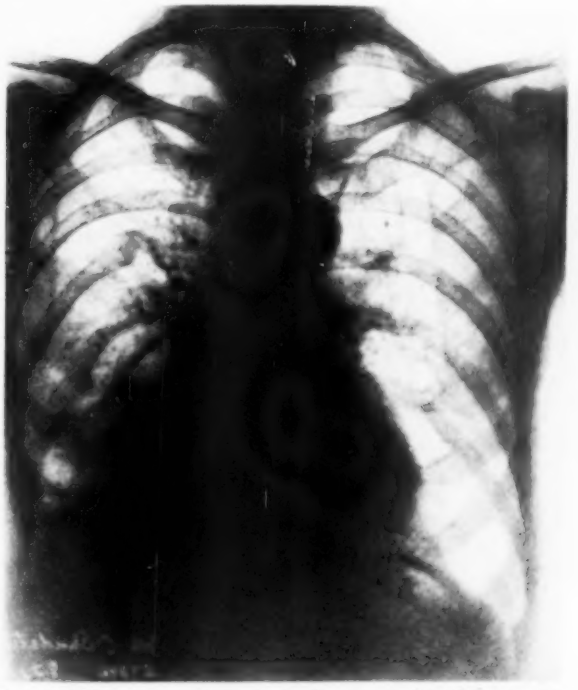

Fig. 7. Roentgenogram made five months after operation. Area of density at right base had gradually cleared up to this time and then remained about same size. Note deformity of seventh, eighth, and ninth ribs on right. Note freedom from metastasis and narrow upper mediastinum. Practically no displacement of intrathoracic viscera is noted.

COMMENT

Because of the fact that this patient had only chest pain, without cough or hemoptysis, together with a large lesion at the

right base in a posterior situation, a diagnosis of a mediastinal tumor was made. At the time of the operation, however, it was found to be a primary bronchiogenic carcinoma with extension into the mediastinum. The course that this patient ran on the operating table and his uneventful convalescence indicates the extent to which surgical procedures can be applied in such cases. Whether the patient was given a longer period of life by the removal of the major portion of the tumor with supplementary radiation is impossible to say. If, however, the surgical cure of such hopeless cases is ever to be expected and hoped for, it becomes our obligation to give the patient that chance.

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SARCOMA OF THE URACHUS

REVIEW OF THE LITERATURE WITH REPORT OF AN ADDITIONAL CASE*

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WHILE lesions of the urachus are not very commonly encountered by the abdominal or urologic surgeon, nevertheless reports of cases of urachal cysts appear in the literature with moderate frequency. Records of solid tumors of the urachus, on the other hand, are noted much less often even though the occurrence of a verified case in one's practice is usually sufficient to warrant its report. Many of the published articles on this subject consist only of reports of isolated cases without attempt at classification or correlation and often only very meager evidence regarding the histologic nature of the tumors is supplied.

In 1927 Dr. Leo Brady[1] of Baltimore reported his case of fibromyoma of the urachus. The patient, a woman of forty-three, was operated upon by him and the diagnosis of fibromyoma proved by microscopic examination of the excised tumor. At this time, he undertook a systematic survey of the literature on the subject and found that including his own case, only 20 cases of solid tumor arising from the urachus were on record. In summary, Brady found that of the case reports which he reviewed, the average age of the patient was forty-four years. The youngest in the series was a boy of eleven who had a primary sarcoma which arose from the sheath of the urachus. The oldest patient was a man of eighty-two with an adenocarcinoma of the urachus with secondary involvement of the bladder. These urachal tumors occurred more commonly in men than in women and in the series of 20, while the sex was not mentioned in 3 cases, only 3 of the remaining 17 patients were women while 14 were men. The symptoms of which this group of patients complained were, chiefly, pain in the middle of the lower abdomen and dysuria, polyuria and hematuria in the event that bladder involvement had taken place. Four patients noted tumor masses in the abdominal wall before they experienced any other symptoms. Of the 20 reported cases, 18 were malignant and 2 benign and of the 18 malignant tumors, 7 were sarcomata and 11 carcinomata. In 14 of the 18 cases of malignant urachal tumor, the bladder was involved at the time that the patient was first examined.

Four years later R. Campbell Begg[2] of New Zealand, published his very comprehensive monograph on the subject of tumors of the urachus. He approached the problem largely from the anatomical and pathological standpoint. After a very critical survey of the cases on record, he rejected from the category of urachal tumors, certain of the cases reported at an earlier date where positive evidence of the nature or origin of the tumor was lacking, and in the light of closer scrutiny reclassified some of the verified tumors. He accepted for his final tabulation 44 authenticated cases in which the evidence submitted seemed sufficiently complete to entitle them to consideration. Begg then classified these urachal tumors according to the following scheme:

(1) Fibroadenoma	3
(2) Adenocarcinoma (not colloid)	4
(3) Colloid adenocarcinoma	19
(4) "Mixed tumors" (including those of unusual pathology)	8
(5) Fibroma and fibromyoma	4
(6) Sarcoma	6
	44

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Regarding groups 5 and 6 in Begg's table, he then pointed out that in his opinion the 10 cases of fibromata, fibromyomata and sarcomata appearing in the table were mesoblastic tumors and strictly speaking should not be considered as true urachal neoplasms. They take origin from non-epithelial structures. They ordinarily arise in the fibrous and muscular strands derived from the umbilical arteries above the true apex of the urachus. Begg states: "There is of course no reason why such tumors should not arise from the same elements in the urachus itself, but as a matter of experience, urachal tumors seem invariably to contain epithelial elements." While this distinction seems to be a legitimate one from the academic standpoint, as a matter of convenience these mesoblastic tumors have usually been grouped with and reported as urachal tumors.

Since Begg's paper there have been added to the literature reports of 3 additional cases of carcinoma of the urachus, one by Andreas Kalo[3] in Budapest, and two by Payne and Jones[4] of Norfolk, Va. No new cases of sarcoma have been found. Having recently had under my care in the surgical clinic of the University of Michigan Hospital a case of urachal sarcoma, I am including a detailed record of this case. This case seems to be of especial interest inasmuch as it appears to be the youngest patient so far reported.

History: An infant girl was brought to the clinic on June 23, 1930, on account of an abdominal tumor. The birth, developmental and past history were all negative. One month prior to admission some enlargement of the abdomen was noted and a mass about the size of an egg felt in the region just below the umbilicus, and extending somewhat to the right. It was thought by the parents that the mass was tender and it had increased in size quite rapidly. There was nothing in the history to suggest a patent urachus.

Examination: The patient was a four-months-old female infant of average nutrition and normal appearance. Temperature on admission was 99°F.; weight 15 lb. 9½ oz.; length 25 in.; mentality apparently normal. The general physical examination revealed no abnormalities of the head, neck or thorax.

Abdominal Examination: There was a palpable mass roughly spherical in form arising from the pelvis and extending almost up to the rib margin and projecting to both right and left sides of the midline, the tumor tending to extend more to the right than to the left. It seemed slightly movable. It appeared to be attached at its upper and lower borders. The contour was smooth and the tumor seemed firm in consistency. It was moderately tender on palpation. There was no evidence of fluid in the abdomen but there was engorgement of the superficial veins. The genitalia and extremities were entirely normal. The Kahn test was negative. Hemoglobin 69 per cent, white blood count 9300. The urine examination was entirely normal. A flat *x*-ray plate was made of the abdomen and chest with the following findings: "Lung fields clear. Abdomen appears greatly distended with gas and there is a shadow of a markedly dilated colon. Small bowel also contains a large amount of gas. There is a homogeneous shadow of extra density filling practically the entire right half of the abdomen."

Diagnosis: In view of the superficial location of the tumor and its evident attachment near the umbilicus and in the pelvis, with some mobility, a tentative diagnosis of a cyst of the urachus was made. The patient returned home for a period of three weeks and then returned to the hospital with essentially no new findings other than the fact that the tumor showed some increase in size.

Operation: A laparotomy was recommended and was done on July 18, 1930 by Dr. F. A. Coller. This was performed under local and nitrous oxide anesthesia. An incision 10 cm. long was made from the symphysis upward. The peritoneum was opened and a tumor mass roughly 11.5 cm. in diameter was encountered. This occupied nearly the entire abdominal cavity, pushing the intestines upwards. It was attached along the anterior wall from the umbilicus to the apex of the bladder. This attachment was cut and ligated and the tumor removed. The peritoneum over the bladder was reconstructed. Abdominal wall was then closed in layers in the usual manner. The patient stood the operation well and the postoperative convalescence was uneventful and she was discharged from the hospital on August 9, 1930.

As soon as the wound was thoroughly healed, a course of *x*-ray irradiation was given. The patient has returned to the hospital for re-

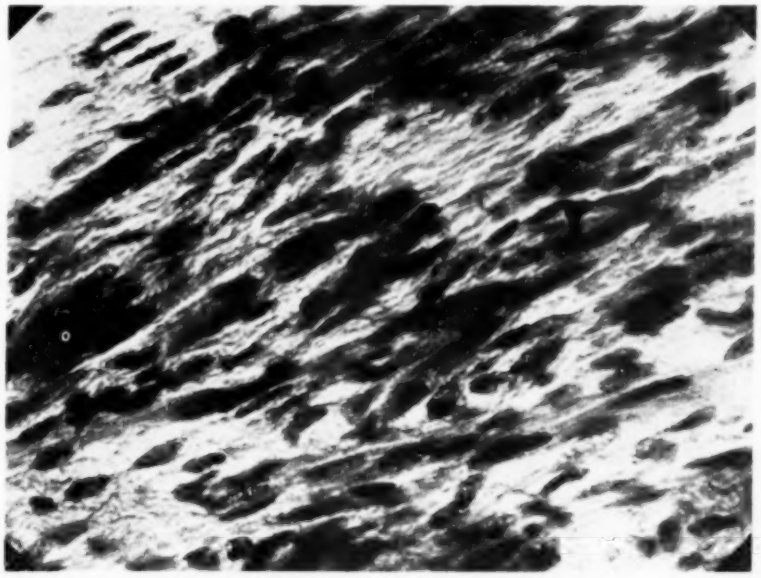

Fig. 1. Case No. 242930. Section of tumor (rhabdomyosarcoma), showing striations in muscle fiber (A). × 300.

examination regularly every six months and no suggestion of recurrence has been found. The last check-up examination was exactly two years following the date of operation and the general health was excellent and growth and development normal in all respects.

Pathological Examination: Grossly the tumor was uniformly firm and solid in consistency, was provided with a definite capsule and on section was homogeneous in nature. The appearance suggested a very cellular neoplasm.

Microscopic examination by Professor C. V. Weller: "Examination of this material shows that while it is a spindle cell sarcoma, the prevailing cell type is an immature striped muscle cell. Such occur in very large numbers and many of them show a stage of development closely approaching the normal adult type. Cross striations can be demonstrated. This is therefore a spindle cell rhabdomyosarcoma. No glandular structures occur, but otherwise it conforms to the general type of Wilms's tumor." (Fig. 1.)

Aside from this case of urachal sarcoma, the other authenticated cases found in the literature are briefly summarized below:

1. In 1897 Grieg Smith[5] in his textbook of abdominal surgery briefly mentioned 2 cases. He states that in his surgical experience he has seen 2 cases of urachal sarcoma. Further details are not given and the subject is dismissed with the statement that "such cases have a pathological rather than a practical interest."

2. Theodor Frank[6] in 1893 described a case of sarcoma which probably had its origin in the sheath of the urachus in a boy eleven years of age. According to the history, there had been loss of appetite and he had been losing weight for several weeks. Two weeks before he was first seen, a small mass had been noted at the umbilicus. Examination showed a hard circumscribed thickening at the umbilical region. Sometime later a laparotomy was performed. The recti muscles and the vertex of the bladder were involved by direct extension while metastatic nodules were found in the omentum. The histological study of the tumor showed it to be a spindle cell sarcoma. From all indications the tumor had developed in the connective tissue layers of the urachus and had then spread out in all directions. The patient survived the operation and was reported as well two months later.

3. F. Villa,[7] an Italian surgeon, in 1902 reported the case of a woman of forty-five who consulted him with a complaint of abdominal pain of three months' duration. Examination revealed a solid tumor in the lower abdomen occupying a midline position and extending from just below the umbilicus to two finger-breadths above the symphysis. At operation the

tumor was found to have infiltrated the recti muscles and extended downward to the vertex of the bladder. The tumor along with the vertex of the bladder and a portion of both recti muscles was removed. The patient recovered from the operation and re-examination eight months later showed no evidence of recurrence. No microscopic studies of the tumor were made but Villa believed from the gross appearance of the tumor that it was a sarcoma.

4. David M. Greig[8] in 1927 reported the case of a woman of thirty. Her chief complaint was a suprapubic tumor which had been noted for eight months. A diagnosis of uterine or ovarian neoplasm was made. An operation was performed. At this time the pelvic organs were found to be normal. The tumor was found situated in the extraperitoneal areolar tissue deep to the transversalis fascia. It was soft but solid and encapsulated by a thin membrane. It had no attachment to the umbilicus and was easily enucleated and at its inferior extremity the delicate capsule concentrated to a fibrous strand which passed to the urinary bladder and this was divided between ligatures well away from the tumor. The convalescence was uneventful and the patient was reported well seven years later. On section, the tumor was of a uniform grayish yellow color, homogeneous in consistency except here and there where degeneration had formed small irregular cavities. The capsule was delicate and thin and did not apparently supply septa to the tumor. Microscopic examination showed it to be a small spindle cell sarcoma.

5. Vöncken and Cambresier[9] in 1927 reported 2 cases of solid tumors of the urachus. Case II in their report is that of a female patient aged thirty who presented herself on account of a tumor in the infraumbilical region of about two months' duration. On examination this tumor was described as being about the size of an orange, fixed and tender to palpation. A laparotomy was performed and the tumor removed without opening the peritoneal cavity. Convalescence was uneventful. The specimen removed measured 4×5 cm. The diagnosis upon microscopic examination by Professor Firket showed the tumor to be histologically a fibrosarcoma.

DOUBTFUL CASES

1. Case reported by E. J. Klopp[10] in 1921. This case was included by Brady in his list of 7 sarcomata but has been rejected by Begg. The patient was a man of fifty who complained of pain about the umbilicus of two weeks' duration. There was a small quantity of yellowish serous fluid which escaped from the umbilicus. After attempt at drainage of this sinus tract had failed, the umbilicus and the tract which extended down to the symphysis were excised in one piece. The histological report is as follows: "The center of the section is occupied by a canal 0.3 cm. in diameter a small arc of which is lined with squamous epithelium and probably represents the original tract. The remainder of the wall of the sinus is inflammatory tissue. Near one margin is a mass of mononuclear cells also containing a few giant cells. It is believed that this area is sarcomatous." Begg states that in his opinion the evidence that this was a tumor of the urachus or even a tumor at all is not satisfactory and he believes that this case should be barred from further consideration.

2. Case reported by Alban Doran[11] in 1909. This patient was a man of thirty-eight who came to the London Hospital complaining of a swelling over the hypogastrium of several weeks' duration and also pain after urination. Examination showed a cystic tumor filling the lower part of the abdomen and extending downward to the loin on the right. At operation a large cyst containing bloody fluid was found. This cyst was densely adherent to the omentum, a part of the intestine and the bladder. It was dissected out but the patient died four days after operation. The inner wall of this cyst was lined in certain places with vascular polypoid masses which proved on microscopic examination to be sarcomatous. Begg, after careful deliberation, has removed this case from the sarcoma group and reassigned it to the group of mixed tumors.

3. Case of Hue and Jacquin,[12] 1868. The patient, a man of forty-five, noticed a tumor the size of a chestnut in the midline of the anterior abdominal wall which caused the umbilicus to become elevated. The tumor was incised and only a small quantity of dark bloody fluid obtained. The wound failed to heal and a fungating tumor mass developed at the site accompanied by a foul discharge. The tumor increased in size so as to involve practically the whole anterior abdominal wall. The patient died fourteen months after the tumor was first noted. Autopsy showed the recti muscles to be replaced by a gelatinous mass. The bladder

was involved by extension into its cavity at a point where the urachus was attached to the bladder, and this was continuous with the colloid tumor mass above. From microscopic study the tumor was regarded as a colloid gelatinous cancer by Laennec; by Virchow as a hyalin or gelatinous myxoma, and by Johannes Müller as a gelatinous sarcoma. In giving his opinion on this case, Begg inclines to the view that this was one of the adenocarcinomata arising in urachal rests left near the umbilicus after the descent of the urachus, the growth afterwards spreading by direct descent to the bladder and involving it secondarily.

4. In 1886 a tumor was demonstrated before the British Gynecological Society and reported by Aveling.[13] The clinical history of the case is not given except for the fact that this tumor was removed after death from a patient who had succumbed following an exploratory operation. The tumor was described as being ovoid in shape and measured 10 in. in length, 7 in. in width and weighed 4¾ lb. It had a thick fibrous capsule. On section it appeared gelatinous and contained several small hard nodules. The microscopic examination was made by Dr. Bland Sutton, who diagnosed it a leiomyoma with sarcomatous areas. As the result of further study however, such authorities as Cullen,[14] Brady, Doran and Begg accept the view that Aveling's tumor was a benign fibromyoma of the urachus rather than a sarcoma as was originally suggested.

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*Continued from p. 198.

LEIOMYOSARCOMA

ANALYSIS OF 31 RECORDED HISTORIES WITH REPORT ON AN UNUSUAL CASE IN THE URINARY BLADDER

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THE finding of an enormous leiomyosarcoma of the bladder in the course of my gynecological practice was so unusual that it led me to make an extended investigation of the existing data on this rare type of tumor. All the cases found in the literature are presented here in tabular form for study and comparison. The rarity of true leiomyosarcoma is attested by the fact that only 31 cases were available, and some of these are of a doubtful character.

The diagnostic criteria for these malignant tumors are ill defined. Generally speaking, the growths are rich in spindle cells of the unstriated, or smooth muscle, variety, occurring in different stages of development and characterized by large, deeply staining nuclei. The fibers may be arranged in definite bundles in intertwining bands, or interspersed throughout the supporting connective tissue. There is a large proportion of immature cells resembling more the cells of the embryo than those of the adult. Mitotic figures are numerous and often atypical in form. Giant cells are common. Areas of degeneration and necrosis are frequently seen. The mass is highly vascular, with little or no stroma, and has the typical flesh-like appearance of a sarcoma. The walls of the blood vessels are usually very thin, sometimes consisting of only one layer of endothelium, through which the tumor cells easily pass into the blood stream and metastasize in other organs.

Opinions differ rather widely as to the exact proportion of adult and embryonic elements essential to the classification of myosarcoma. It is hoped that this paper will stimulate the interest of pathologists in agreeing upon a standard by which malignancy or potential malignancy can be determined.

The number of mitotic figures is usually held to have diagnostic significance. Evans considered 2,200 to 12,000 for each cubic millimeter of tissue as indicative of clinical malignancy in uterine myomas. According to the accompanying table, however, metastasis has occurred after a microscopic finding of "very few" mitotic figures. In this connection, it must be noted that an extremely painstaking search is required in order accurately to estimate the extent of mitosis throughout a large tumor mass. According to Meaker, irregularities and inequalities of size, shape and arrangement, differentiation and staining reaction afford a better criterion of malignancy than mitotic figures, giant cells, scanty stroma and newly formed blood vessels.

Clinical, or preoperative, diagnosis is still more baffling. Upon referring to the table, it will be seen that leiomyosarcoma is but rarely recognized as such before the specimen is reported on by the pathologist. The patient's symptoms are a very poor guide. Perhaps the most striking point brought out by this analysis is the wide variety, or extraordinary absence, of symptoms. In the second of Meaker's cases, an enlarging abdomen was the sole indication. In my own, the symptoms were misleading as to the locale of the growth and there was nothing to indicate its malignancy. Pedunculated tumors of the uterus are considered by some authorities as likely to be very malignant, and a pink, watery discharge as more diagnostic than blood.

Dannreuther has listed certain macroscopic features by which the surgeon may

be led to suspect malignancy in uterine tumors at the time of operation,* but as Meaker comments, from his own experience, these signs are not infallible.

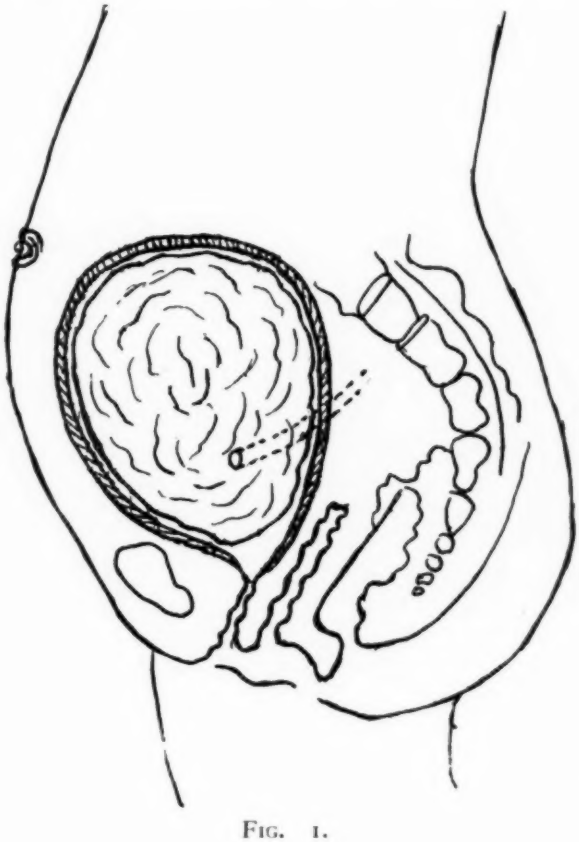

Fig. 1.

This uncertainty creates an embarrassing situation for the surgeon, as is well illustrated by Gardner's classical case of general metastasis from a tumor apparently benign. The extreme position taken by some physicians of regarding as malignant all leiomyomas showing any degree of sarcomatous change has some grounds for justification. On the other hand, leiomyomas are often found to be histologically malignant while clinically benign. It is only after a certain proportion of malignancy is established that the growth becomes a menace to life, and it is this important dividing line that has not yet been drawn.

I am in full agreement with Meaker's suggestion that every myomatous uterus should be opened and examined before the operation is concluded. If there are any indications that the growth is malignant, panhysterectomy should be done. When a diagnosis of leiomyosarcoma is not returned for some days after a supravaginal hysterectomy, the stump should be treated with radium through the cervix.

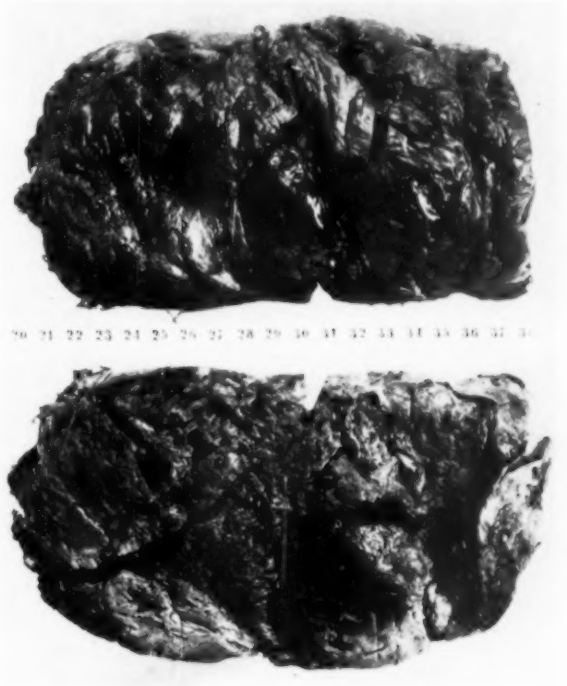

Fig. 2.

As might be expected, leiomyosarcomas are found far more frequently in the uterus than in other organs, although the gastrointestinal tract is a not uncommon seat. Three only are reported as involving the bladder. The case reported below appears to be unique in its great size; its almost perfect encapsulation; absence of the classical symptom of blood (either macroscopic or microscopic) in the urine; the impossibility of introducing a cystoscope by which a more accurate diagnosis could have been made; and the fact that the indications were such that it came into the hands of a gynecologist for operation.

* Unusual friability of the broad ligaments; remarkable vascularity of the tumor; indefinite demarcation between tumor and myometrium; difficulty of enucleation; opaque appearance on section; soft cut surface appearing edematous and sparsely fasciculated.

THIRTY-ONE CASES OF LEIOMYOSARCOMA REPORTED IN THE LITERATURE*

Reporter	*Sex & Age*	*Symptoms*	*Preoperative Diagnosis*	*Gross Specimen*	*Microscopic Findings*	*Metastasis*	*Postoperative Diagnosis*	*Site*
Caylor and Walters	M. 4	Frequency, incontinence, dysuria, hematuria. Cystoscopy showed two masses in bladder	Exploratory operation	Two pedunculated tumors, 7.5 and 4 cm. in diameter, polyp-like, grayish white	Large cells like smooth muscle cells, some in bundles, others scattered. Some contained multiple nuclei. Mitosis rare. Bladder wall invaded by malignant cells. Myxomatous areas near surface of masses	One of these growths may have been metastatic. None seen elsewhere. Recurrence two months postoperative	Leiomyosarcoma with multiple areas of myxomatous change	Bladder
Hager and Hunt	F. 53	Hematuria, nocturia, pelvic pain. Cystoscopy revealed tumor in bladder wall	Biopsy suggested myosarcoma	Tumor mass 2.5 × 2.5 × 2 cm.	Intertwining smooth muscle fibers, some in bundles, others interspersed throughout fibrous connective tissue. Nuclei of cells conspicuous with few mitotic figures	Not known	Leiomyosarcoma‡ graded I	Bladder
Krauskopf	F. 60	Frequency, enlarging abdomen. Abdominal pain. History of panhysterectomy ten years ago. Large mass palpable in abdomen	Ovarian or par-ovarian tumor	Tumor mass 18 × 9.5 × 3.6, weight 420 gm., white-brown color, well encapsulated	Large amount of smooth muscle fibers, some well developed, others immature. Nuclei oval or oblong. Numerous mitotic figures, 8 to 40 per field, in various stages of mitosis. Many cells show mucoid and hyaline degeneration. Very little connective tissue	Not known, as no autopsy was made	Leiomyosarcoma rapidly growing	Bladder
Berry	F. 26	Pain in right loin, polyuria, nocturia	Tumor of right kidney	Enlarged kidney with large, firm, whitish growth at lower pole, well encapsulated	Intertwining bundles of smooth muscle cells, varying in maturity. Some show large, vesicular nuclei. Occasional mitotic figures. Capsule invaded and split in places by growth	Not known	Leiomyosarcoma	Kidney
Cohen	M. 65	"Failing health" following "stroke" two years ago. Liver enlarged, hard nodule palpable at lower lobe	X-ray showed 6-hour retention due to mass in stomach, which was interpreted as carcinoma	Necropsy showed primary leiomyosarcoma in left kidney, with small metastatic nodule, firm, yellowish-green, with central necrosis	(Given only for secondary tumor of brain.) Cells irregular, spindle shaped. Cytoplasm stained lt. blue and showed longitudinal striations. Nuclei oval, elongated, centrally limited and contained a central, spherical nucleolus. Both stained dark blue	General. In both lungs, kidney, suprarenal glands, ileum, mediastinal and mesenteric lymph nodes and brain	Leiomyosarcoma	Kidney
Cabot Case #12323	F. 40	Pain in R.L.Q. Menorrhagia, clots, pink discharge from entroitus. History of pedunculated tumor in vagina	Not recorded	Enlarged uterus containing tumor size of orange, soft, white, translucent. No capsule. Small fibroids in cervix and vaginal wall	Rich growth of atypical spindle cells in bundles, varied in size and staining reaction. Occasional mitotic figures	Sixteen months later a large tumor was reremoved from vagina	Leiomyosarcoma	Uterus
Cohen	F. 47	Irregular menstruation, intermenstrual bleeding. Abdominal cramps, dyspnea, night sweats, frequent micturition. Hard mass palpable in abdomen	Not recorded	Necropsy revealed multiple white, firm nodules in uterus	Cells larger than normal with fairly large, fusiform, round and oval nuclei, some multiple. Scanty stroma, irregularly fibrillar	Secondary nodules in lung and liver	Leiomyosarcoma	Uterus
Dannreuther	F. 44	Menorrhagia, with clots. Uterine tumor palpable	Fibroma of uterus	Hard, encapsulated tumor 6.5 cm. in diameter, accompanied by smaller mass and nodule	Fairly well-developed smooth muscle cells with nuclei varying in size and shape and many mitotic figures. Highly vascular	Not known	Leiomyosarcoma†	Uterus

Dannreuther	F. 47	Menorrhagia. Several hard, globoid tumors palpable in uterus	Fibromyoma of uterus	Two pedunculated subserous tumors 3 × 2 × 2 cm. and 6 × 4 × 4 cm. respectively. Numerous small intramural tumors. One large tumor 6.5 × 5 × 5 cm.	Incompletely differentiated smooth muscle cells in several areas, with many mitotic figures, apparently infiltrating the tumor wall. Edematous stroma	Not known	Leiomyosarcoma†	Uterus
Dannreuther	F. 46	Menorrhagia, enlarged abdomen. Hard mass palpable in uterus	Fibromyoma of uterus	Partly encapsulated tumor 11 cm. in diameter	Highly cellular and vascular mass with closely packed leiomyoblasts, mostly showing very little differentiation. Mitotic figures rare. Nuclei large, blunt and deeply staining. Stroma scanty and highly vascular, some vessels showing organizing thrombi	Not known	Leiomyosarcoma†	Uterus
Dannreuther	F. 50	Menorrhagia, enlarged abdomen. Frequency of urination. Large mass palpable in uterus	Fibromyoma of uterus	Tumor 10 cm. in diameter, soft and semitransparent, accompanied by long soft polyp and intramural nodule	Large tumor rich in fairly well-developed smooth muscle fibers with very little stroma. Mitotic figures rare. Highly vascular	Not known	Leiomyosarcoma†	Uterus
Dannreuther	F. 38	Metrorrhagia, menorrhagia, pelvic pain. Uterine tumor palpable	Fibromyoma of uterus	Uterus and adnexa measured 166 × 132 × 109 mm. Several large tumors in uterine wall	Numerous rapidly growing smooth muscle cells. Mitotic figures very frequent. Myometrium apparently invaded, with offshoots of tumor filling blood vessels	Two nodular areas of infiltration in lung suggest metastases	Leiomyosarcoma	Uterus
Dustin	F. 52	Sanguinous discharge. Tumor mass palpable in cul-de-sac. History of uterine fibromyoma removed 8 months earlier	Not operated on. Treated with radium	Biopsy	Biopsy specimen showed elongated cells. Numerous mitotic figures. Atypical nuclei, polymorphs and giant cells	None (this growth probably secondary)	Leiomyosarcoma	Uterus
Gardner	F. 55	Sense of fullness in abdomen. Frequent urination	Uterine fibroids	Uterus (supravaginal) with tumor attached, 25 × 18 × 18 cm. in left broad ligament, accompanied by smaller growth	(Postmortem) Smooth muscle cells with frequent mitotic figures. (Necessity for using a celloidin section of tumor for examination accounts for incomplete findings)	General. Seven months later, growth diagnosed as a fibroid was removed from sacroiliac synchondrosis, followed in one month by neurofibromatosis on back, and 6 mos. later by a spinal tumor diagnosed as malignant leiomyoma. Autopsy revealed metastases in scalp, back, breast, abdominal wall, pelvis, pleurae, lungs, liver, kidneys, pancreas, aorta, skull (subdural) and spinal cord.	(Original) Multiple myomata (Final) Leiomyosarcoma	Uterus
Hare	F. 55	Extreme constipation suggesting obstruction. History of small tumor 15 years ago, not removed	Exploratory laparotomy	Numerous fibroids filling pelvis; nodules throughout abdomen. Masses total 3 lbs.	Not given. Histology said to be that of leiomyosarcoma	Numerous in abdomen	Multiple myomata; malignant leiomyomata	Uterus

THIRTY-ONE CASES OF LEIOMYOSARCOMA REPORTED IN THE LITERATURE* (*Continued*)

Reporter	*Sex & Age*	*Symptoms*	*Preoperative Diagnosis*	*Gross Specimen*	*Microscopic Findings*	*Metastasis*	*Postoperative Diagnosis*	*Site*
Meaker	F. 40	Amenorrhea, abdominal enlargement. Pelvic pain. Hard tumor mass palpable	Leiomyoma of uterus	Spherical uterus 12 cm. in diameter, no cervix discoverable	Closely packed, deeply staining, somewhat elliptical cells having little cytoplasm and nearly uniform in size. Numerous mitotic figures. Walls of fallopian tubes densely infiltrated	In lungs a year later	Leiomyosarcoma rapidly growing	Uterus
Meaker	F. 31	Enlarging abdomen. No other symptom	Leiomyoma of uterus	Uterus 20 × 17 × 14 cm., containing gray, encapsulated mass	Interweaving bands of smooth muscle fibers, varying in size and staining reaction, with numerous pyknotic nuclei. Large areas of degeneration. Moderate vascularity. Occasional mitotic figures	None 18 months later	Leiomyosarcoma†	Uterus
Meaker	F. 39	Menorrhagia with clots	Leiomyoma of uterus	Enlarged uterus containing pedunculated nodule, pale colored and firm, 2.5 × 3 × 3 cm., with smaller tumors in myometrium	Interweaving smooth muscle fibers with very little stroma, poorly vascular. Muscle fibers hyperplastic, faintly staining and somewhat irregularly shaped. Numerous mitotic figures. Several diasters	None a year later	Leiomyosarcoma†	Uterus
Meaker	F. 45	Menorrhagia, enlarged uterus	Leiomyoma of uterus	Supracervical uterus containing tumor 7.5 × 6 cm., with one small subserous tumor mass	Bundles of smooth muscle cells with considerable moderately vascular stroma. Cells vary in size, shape and staining reaction, are hyperplastic and present frequent mitotic figures	None 8 months postoperative	Leiomyosarcoma†	Uterus
Sage and Miller	F. 56	Abdominal enlargement and pain. Foul, purulent, serosanguinous discharge, nausea, vomiting. Hard mass palpable from pelvis to costal borders	Uterine fibroma with malignant degeneration and suppuration	Complete uterus containing tumor 15 × 7 cm., weight 5½ lb.	Long spindle cells, some polygonal, with eosin staining cytoplasm. Large nuclei, elongated and round. Many giant cells. Abundant mitotic figures, many atypical. Growth has invaded blood vessels and muscle tissues	Not known	Leiomyosarcoma	Uterus
Lewis	F. 51	Diarrhea and pain in back. Mass palpable in pelvis. History of leiomyomata removed from uterus 7 years ago	Sarcoma of cervix	Encapsulated tumor weighing 585 gm.	Smooth muscle cells of irregular size, mostly round and spindle shaped. Some foci very cellular, others necrosed. Numerous blood vessels and frequent mitotic figures	Numerous firm nodules in pelvis, peritoneum and liver. Recurrence in pelvis 2 months postoperative	Leiomyosarcoma rapidly growing	Cervix
Antonow	F. 21	Dyspepsia, periodic abdominal pain. Firm mass size of orange palpable below right abdominal rectus	Mesenterial or omental tumor	Tumor extending along entire length of resected stomach, into duodenum to gastrocolic ligament and to middle of lesser curvature	Immature sarcomatous muscle cells in parallel bundles. Pure leiomyomatous portions show bundles of delicate fibrils. Cells are round, oval, star shaped, fusiform and anastomosing or vacuolized, with similarly shaped nuclei. Areas of hyaline connective tissue and hemorrhagic detritus. Mass very vascular. Mitotic figures few	To lymph nodes of gastrocolic ligament and omentum minor	Malignant multiple leiomyosarcoma	Stomach
Schiff and Foulger	M. 50	Chills and fever, pain and swelling in epigastrium. Constipation. Mass palpable just below left costal margin	Enlarged spleen, gastric ulcer	Necropsy showed large mass of gastric mucosa along lesser curvature of stomach with ulcer 7 mm. in diameter in center	Edges of ulcer consisted of tumor tissue. Histology that of leiomyosarcoma (details not given)	In liver and lung	Leiomyosarcoma‡	Stomach
Trygstad	M. 19	Frequent attacks of cramp-like abdominal pain localized in left side; nausea, vomiting. Mass palpable in left lumbar region, size and shape of a kidney	Not made. Exploratory laparotomy	Tumor 6 cm. in diameter at ileocecal junction. Intussusception of ileum, cecum and ascending colon into transverse colon. Tumor mass pinkish white, soft and edematous	Bundles of unstriped muscle cells, some mature and others less so. Immature cells are much larger with round or oval nuclei having occasional mitotic figures. Numerous plasma cells and eosinophiles	Not known	Leiomyosarcoma	Cecum

Gohn and Hintz	M. 35	Fatigue, backache, edema of feet, painful tumor palpable in right hypochondrium	Malignant intestinal tumor. Not operated on	Autopsy showed pedunculated tumor size of nut suspended from tip of invaginated portion of ileum. Metastatic tumors varied in size from millet seed to man's fist	All tumors presented interlacing cell bundles suggesting leiomyomatous structure with very little interstitial tissue; necrosis and liquefaction; little hyaline degeneration. Cells variable in size, shape and staining reaction. Nuclei oval or fusiform, blunt, irregularly vacuolized	General. In lungs, thyroid gland, liver, pancreas, kidneys, adrenals, intercostal muscles, gastric wall, small intestine, bone marrow of vertebrae, right femur, periosteum of sternum	Malignant leiomyoma	Ileum
Cabot Case #16142	F. 50	Oppression in chest, numbness of hands, edema of ankles, enlarged liver. Microscopic blood in stools	1. Cirrhosis of liver with varices. 2. Probable leiomyosarcoma. 3. Benign polyp. 4. Peptic ulcer	Section of jejunum with tumor 4 × 5 × 5 cm. attached by pedicle and overlain by small ulcer	Fair amount of interweaving bands of spindle cells. Moderate amount of stroma. 10 to 15 mitotic figures per field	Not known	Leiomyosarcoma†	Jejunum
Cattell and Woodbridge	M. 40	Abdominal pain and tenderness, constipation, gas	Perforating peptic ulcer	Section of jejunum containing nodular tumor 8 × 4½ × 4 cm.	Very cellular with numerous mitotic figures. All layers of the bowel wall invaded	No evidence at necropsy	Leiomyosarcoma	Jejunum
Smith	F. 50	Not given	Not given	Small, spherical masses from intestine and liver less than 1 cm. in diameter, white and dense; definitely encapsulated	Not given. Histology that of metastatic leiomyosarcoma	In liver and intestine. Origin probably gastrointestinal or uterine	Leiomyosarcoma (secondary)	Liver§
Catron	F. 83	Pain in left side and chest. Hardened arteries. No sign of intrathoracic tumor	Hypertensive heart disease; arteriosclerosis	At necropsy, lower lobe of left lung was found compressed by a firm tumor mass 22 × 18 × 8 cm., encapsulated by thickened pleura, to which the lung was adherent	Large tumor cells, ovoid, fusiform or irregular, with nuclei centrally placed. Very few mitotic figures. Stroma typical collagenous connective tissue, scanty in parts and abundant in others. Numerous thin-walled blood vessels, some containing mixed thrombi. Some areas of hyaline degeneration and complete necrosis	None	Leiomyosarcoma†	Pleura
Neumann	F. 48	Progressive subcutaneous growth on left foot, movable on base, painful on application of cold or pressure	Fibroma	Sharply delimited, hard oval tumor 4.5 cm. in diameter	Leiomyoma enclosing a vein whose wall is merged with tumor tissue. Bundles of interlacing smooth muscle cells of sarcomatous type. Blunt or rod-shaped nuclei irregular in size, shape and staining reaction, some vacuolized, some with nucleoli. Mononuclear round cell infiltration on periphery of tumor	None	Primary leiomyosarcoma	Foot: dorsum at level of talocrural joint
Silva	F. 46	Growth involving left labium majus, which has increased slowly at first and then rapidly	Tumor of vulva, probably malignant	Whitish, pedunculated tumor with tendency to lobulation. At the peduncle were sections of numerous small blood vessels	Neoplasm covered by normal skin, with subcutaneous tissue well developed, no trace of infiltration. Neoplastic tissue in different stages of development. Near peduncle tumor was leiomyoma, but not typical. Fasciculate structure was evident, but there were signs of malignancy. Atypic cells abounded, with some mitosis. Definitely sarcomatous cells in some areas	Not mentioned	Sarcomatous† Leiomyoma	Vulva

* A few other tumors so classified present such indefinite claims that they have not been included here (see Gohn and Hintz for 2 cases of myosarcoma associated with carcinoma).

† Whether or not this growth is a true *myoma malignum* has been thought by some not to have been fully established, although it exhibits many of the characteristics and is diagnosed as a leiomyosarcoma.

‡ Two other cases occurring in the stomach were reported by Schuejeninow, but the publication is not available in the Library of the New York Academy of Medicine (see References).

§ See Feldman for a report of leiomyosarcoma of the spleen found in a cow at necropsy, a condition so rare as to be a curiosity.

CASE REPORT

R. L., white, female, aged sixty plus, was admitted to the gynecological department of the Jewish Memorial Hospital on May 16, 1929. She complained of frequency of urination, slight loss of weight and a gradual increase in the size of her abdomen.

History: A laparotomy had been performed ten years ago for fibroid uterus. As the uterus was absent, panhysterectomy was presumably done at that time, although the record of this operation is incomplete. There had been extreme frequency of urination for two years. For the past month the patient had had but little control of her bladder. Gradual enlargement of abdomen during the past six weeks was noted, with general lassitude and backache. There was no vaginal discharge. Bowels were regular. She had never to her knowledge passed either blood or bloody urine. There was considerable abdominal pain of a constant dull, aching character.

Physical Examination: The patient was a fairly well-nourished female, with nothing remarkable except a semi-solid, oval mass in the midline reaching from the umbilicus down to and below the symphysis pubis. Vaginal bimanual examination revealed no cervical stump. A tumor filling the entire true pelvis was palpable through the cul-de-sac.

It was impossible to introduce a solid catheter, but a few drops of clear urine were obtained with the soft catheter. No cystoscopy could be done. The genitourinary department was unable to improve this technique. Urinalysis showed some turbidity; albumin 2 plus; no sugar, acetone or diacetic acid; many white blood cells; *no red blood cells.*

Preoperative Diagnosis: Abdominopelvic tumor, probably of ovarian or parovarian origin, impinging on the bladder and reducing its capacity to a minimum.

Operation: Exploratory laparotomy. Through a midline incision over the tumor extending from the symphysis pubis to the umbilicus, through skin and fascia, the anterior surface of the tumor mass was brought into view. This suggested that the tumor was extraperitoneal and probably of bladder origin, which was confirmed by careful dissection at the lower portion of the tumor revealing the entering ureters.

Incision was made along the whole length of the anterior bladder wall, ending above the entrance points of the ureters. The wall was thickened to about ¾ inch, with a considerably hypertrophied muscular layer. The line of demarcation between the bladder wall and the tumor was now quite distinct, the tumor occupying almost entirely the immensely distended bladder cavity.

Free dissection of the mass springing from the anterior wall was then easily accomplished, with little or no bleeding, as the posterior portion was thoroughly encapsulated. A Marion tube, held by linen sutures, was left in situ.

The postoperative course was uneventful until the thirty-third day, when there was a sudden suppression of urine, with convulsive seizures. On the thirty-sixth day, a sudden rise in temperature to 104.8°F., with convulsion, was followed by death.

Pathological Report: Gross characteristics: A flat, slightly oval tumor, white-brown in color; about 18 × 9.5 × 3.6 cm. Weight 420 gm. Surface irregular, with some superficial and deeper notches and elevations. The cut surface shows a more homogeneous mass, mottled in appearance. The brownish parts are fleshy and semi-soft. The white parts are soft and resemble degenerated tissue. There are signs of capsule formation.

Microscopic: A large amount of smooth muscle fibers, some well developed and others fairly well developed, with nuclei oval or oblong; few empty capillaries. Many fibers show hyaline and mucoid degeneration. There are from 8 to 40 mitotic figures per field, in various stages of mitosis. A few connective tissue fibers are occasionally visible.

Diagnosis: Leiomyosarcoma of the bladder.*

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[For Remainder of References see p. 191.]

* This diagnosis was confirmed by a number of pathologists, who considered it a remarkable specimen.

FOREIGN BODIES IN THE URINARY BLADDER*

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FOREIGN bodies of all types and description have been found in the urinary bladder.

These objects may gain access to the bladder by wounds received both in war and civil accidents, by surgical procedures, pathological perforation of the bladder wall and by introduction into the urethra.

The greatest majority of these foreign bodies enter the bladder via the urethra. Introduction of such objects into the urethra are due to insanity or to produce sexual excitement and gratification. In the female many cases are due to the patient attempting to produce an abortion, with the object accidentally slipping into the bladder.

Foreign bodies of larger size and greater variety have been found in the female than the male due to the short length and elasticity of the female urethra. Due to the fact that most of these objects have been used to produce erotic sensations or abortion, the patient at times tolerates the discomforts of the ordeal for a long period of time before consulting a physician. Because of this elapsed time a large percentage of foreign bodies are encrusted with calcareous deposits, some being the nucleus of a calculus, as in one of our cases.

Foreign bodies of metallic composition become encrusted with calcareous deposits most quickly. Objects of rubber, wood and linen also become quickly encrusted. Paraffin and wax objects very rarely become encrusted to any extent.

If the surface of the foreign body is rough such a deposit rapidly ensues, more so than if it were smooth.

If the object is elongated the deposit will occur first in the middle, rather than on the ends.

The symptoms of a foreign body in the urinary bladder naturally vary with the nature of the object, the length of time it has been present in the bladder, complications, etc. Frequent and painful urination will be present soon after the introduction of the object into the bladder. The pain may be present between intervals of micturition or during the act of micturition. A terminal hematuria usually is present in forty-eight to seventy-two hours which may later become a gross finding during the entire act of urination. Later all symptoms of a violent cystitis present themselves with bladder spasm, strangury and the like. If the foreign body should be of such a nature as to erode into the bladder wall, perforation may result with symptoms of a peritonitis or pelvic cellulitis, depending on the point of perforation.

The diagnosis at times may be delayed, due to the frequent unreliability of the histories which are obtained from these patients. However, after careful examination with the use of radiography and cystoscopy the diagnosis will be cleared and the exact nature of the foreign body determined.

Treatment is essentially surgical. Many foreign bodies can be removed by means of the cystoscopic rongeur while others may have to be removed by suprapubic cystostomy. Each case is a case unto itself and the method of attack by the operator falls entirely upon his good judgment.

* From the Department of Genito-Urinary Surgery, University Hospitals, Indiana University School of Medicine, St. Vincent's Hospital, Indiana Christian Hospital and the Indianapolis City Hospital.

CASE REPORTS

CASE I. S. Y., a female, aged thirty, entered the University Hospitals complaining of pain in her left side and burning on urination. Her illness dated back two months. She was placed on the Surgical Service and examination revealed a dry skin and an emaciated individual. Abdominal tenderness was pronounced with some rigidity over the lower abdomen. Her temperature ran from 98.6° to 100°F. Gynecological consultation revealed what was thought to be definite pelvic pathology.

Urinalysis disclosed large amounts of pus and some blood; albumin 1 plus to 2 plus; sugar, negative.

Laparotomy was done and the uterus found to be enlarged and having the appearance of an early pregnancy. The tubes and ovaries appeared normal. No disease was found to account for the symptoms. The appendix was removed and the abdomen closed. Convalescence was uneventful but with no change in the clinical picture.

Ten days after the laparotomy she was transferred to the Urological Service and was seen by one of us (W. P. G.). Cystoscopy revealed a fulminant cystitis of such a degree that satisfactory examination was impossible. Catheter drainage and irrigations for a period of two weeks relieved all the symptoms greatly and on cystoscopic examination a large piece of slippery elm bark encrusted with calcareous deposit was seen. The bark had eroded into the bladder mucosa in several places causing definite necrosis.

One week later the piece of bark (Fig. 1) was removed by one of us (W. P. G.) by means of grasping it with a rongeur through a large caliber operating cystoscope.

Convalescence was uneventful and two weeks later cystoscopy revealed a practically normal bladder wall throughout.

FIG. 1.

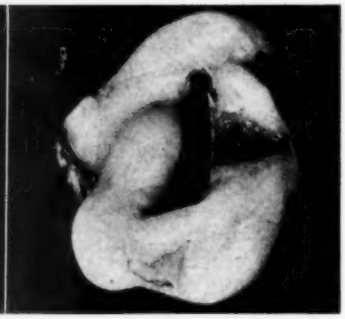

FIG. 2.

FIG. 1. Case I. Slippery elm bark, 3 inches in length and ¾ inch width. Foreign body removed with an operating cystoscope.

FIG. 2. Case II. Pink tallow candle 3 inches in length and ¼ inch in diameter. Removed by suprapubic cystotomy.

Two months after the patient's dismissal from the hospital she delivered a full term, normal baby boy, which weighed 9 pounds.

This case is of interest in that it demonstrates the difficulties of such a diagnosis at times.

The patient admitted only after removal of the slippery elm bark that she had attempted to abort herself two months before entering the hospital. She had suffered agony for five months and had undergone a major abdominal procedure but still kept her act a secret.

CASE II. F. S., a male, aged eighteen, came into our office complaining of burning and painful urination. He admitted having passed a pink tallow candle into his urethra forty-eight hours before and that it had accidentally slipped from his grasp. He denied the practice of masturbation and stated that he was "scratching himself" at the time of the accident.

Within a few hours frequency and burning on urination developed and at the end of twenty-four hours he noticed a terminal hematuria. During the second twenty-four hours these symptoms became aggravated and he sought medical aid.

He was sent to St. Vincent's Hospital and cystoscopy revealed the candle floating near the roof of the bladder. Upon attaining body temperature and having become softened, the candle had completely curled up, due possibly to bladder spasm. A violent cystitis of the entire bladder was present.

Suprapubic cystotomy was done and the candle (Fig. 2) removed.

The boy made an uneventful recovery and was dismissed from the hospital on the twenty-third day with the suprapubic wound completely healed.

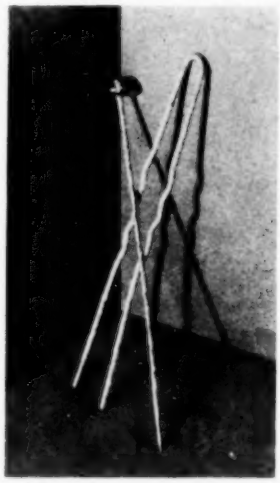

Fig. 3. Case III. Hairpin coated with phospatic deposit removed with an operating cystoscope.

Case III. C. S., a female, aged nineteen, was seen at the Indiana Christian Hospital complaining of painful urination. She admitted that two days previously she had used a hairpin to produce "exciting sensations" and that it had slipped away from her and could not be located. Within a very short time frequency, burning and strangury developed and had gradually become aggravated.

Cystoscopy revealed a large, heavy, steel hairpin which had embedded its two forks into the bladder-neck just above the internal orifice, with the rounded end of the hairpin pushing itself into the fundus of the bladder. Over-distention of the bladder with fluid released the rounded end of the hairpin sufficiently for it to be plainly seen, but the two open forks remained fixed and embedded in the bladder neck.

The hairpin (Fig. 3) was then removed by one of us (W. P. G.) in the following manner:

Working through an operating cystoscope of large caliber, a wire loop was thrown around the round end of the hair pin and the object was then dislodged from its fixed position and turned around. The round end was then drawn closely into the fenestra of the cystoscope and the entire apparatus was then gently removed thus pulling the hairpin out of the bladder, trailing the cystoscope.

Recovery was uneventful and the patient was dismissed on the second day postoperative.

Case IV. C. S., a male, aged thirty, married, came into our office complaining of difficulty in passing his urine. His symptoms had started about four months before with frequency and burning. All the symptoms gradually became worse and during the past few weeks dribbling and difficulty in starting and passing his stream had developed.

Fig. 4. Case IV. Large phosphatic calculus with "juicy fruit" chewing wax nucleus. Removed by external urethrotomy.

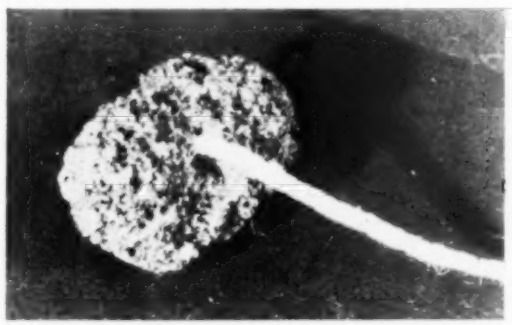

Fig. 5. Case V. Phosphatic calculus formed on end of linen suture. Second stone broken off of thread and lost.

After examination, instrumentation and *x*-ray, a diagnosis of a calculus in the posterior urethra was made.

External urethrotomy was done by one of us (W. P. G.) and with much difficulty the calculus (Fig. 4) was removed. It was found to be a dumb-bell shaped stone, half being in the posterior urethra and the other half occupying the portion of the bladder just inside the internal sphincter.

When the stone was opened a chewing gum nucleus was found which was definitely "juicy fruit" in odor. On questioning of the patient,

he finally admitted having used a chewing gum bougie to "scratch his urethra" some four or five months before. Information was also obtained from his brother that he had practiced masturbation for years.

The patient's postoperative recovery was uneventful until the fourteenth day when he began to lose ground. Eventually a diagnosis of typhoid fever was made and after a stormy sequence of developments encountered in this dreadful malady, the patient finally recovered and left the hospital.

Case v. B. S., a female, married, aged thirty-seven, was admitted to the Indianapolis City Hospital, complaining of pain in the lower abdomen. After study by the gynecological staff a sub-total hysterectomy was done for chronic salpingitis. During the procedure the bladder was accidentally opened and was repaired with linen suture. Convalescence was uneventful.

She was again admitted to the hospital three and one-half months later complaining of frequency and burning of urination. She also stated that "something was hanging from her bladder." (Fig. 5.) Examination revealed a linen thread hanging about 2 inches out of the urethra. Two stones about the size of a marble were formed about the distal end. Traction on the thread caused some pain in the region of the bladder.

An operative cystoscope was introduced into the bladder and the thread followed to its point of insertion in the roof of the bladder wall. At this point definite inflammation and some edema were present. The thread was cut loose from its attachment by one of us (J. F. B.), with a pair of cystoscopic scissors.

All the bladder symptoms were at once relieved and the patient left the hospital on the second day.

Comment: Here we believe a word of caution is in order. The bladder should never be sutured with a non-absorbable material, such as silk, linen, etc. They act as foreign bodies and as nidi about which calculi form. We have recently seen 3 cases of vesicovaginal fistula occur following suture with linen of an accidentally injured bladder during vaginal hysterectomy.

CONCLUSIONS

1. Five cases of foreign body in the urinary bladder are herein reported, three of which were introduced to produce sexual excitement, one to produce abortion and one following a surgical injury to the bladder.

2. Three of the foreign bodies were removed cystoscopically, one by suprapubic cystostomy and one by external urethrotomy.

SEVERE HEMORRHAGE INTO THE BLADDER

DISCUSSION OF SUCH HEMORRHAGES AND CASE REPORT OF AN UNUSUAL AND ALMOST FATAL HEMORRHAGE

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ATLANTA, GA.

OCCASIONALLY the urologist encounters a patient having such rapid bleeding into the bladder that the bladder becomes overdistended with blood clots.

The usual causes of sudden hemorrhages are carcinoma of the bladder and benign prostatic hypertrophy, but occasionally, they come from wounds of the urethra or of the vesical orifice which have been caused by a urethral catheter or by an intravesical operation performed through the urethra.

With proper instruments it is fairly easy to remove any quantity of even tough clots through the urethra. And after that is done the hemorrhage often stops at once if the bladder is gently irrigated with quite hot water. Where hot irrigations do not suffice, coagulation of the bleeding point or points with the high frequency current should be tried. Should all these measures fail then suprapubic cystotomy must be done at once if the hemorrhage is still severe; cauterization or electric coagulation, prostatectomy, the insertion of a Hagner bag are some of the things which may have to be employed through the suprapubic wound. Spinal anesthesia is useful in these cases because the rapidly produced and complete relaxation obtained is helpful in controlling the bleeding.

I do not intend to include here a discussion of the hemorrhages which occur following prostatectomy, but I would like to record an observation about them which I have found to be of value, that is, that such hemorrhages (and also the severe ones following transurethral prostatic resection) have, in my experience, occurred usually in the patients who have had a history of attacks of bleeding into the bladder before prostatectomy, or who have bled easily and rather freely on cystoscopy and have continued to bleed for some time after cystoscopy. I have rarely seen a hemorrhage of any importance in a patient who did not bleed at all at cystoscopy or who, even though he bled rather profusely for a short time, stopped immediately so that the cystoscopic examination was satisfactory.

Only once have I had the misfortune to lose a patient from bladder hemorrhage. In that instance the patient was a large man, rather fat, with a great, benign enlargement of the prostate protruding far out into the bladder (it was so large that the removed fragments more than filled a pint jar). In the mucous membrane which covered the large intravesical protrusion were many enlarged veins. Before coming to me for prostatectomy he had had four or five rather severe hemorrhages occurring every few months and continuing for several days. They evidently came from the enlarged and engorged veins. I decided upon a two-stage prostatectomy but in twenty-four hours after I did the suprapubic cystotomy a severe and uncontrollable bleeding began. On re-opening the bladder I found that the bleeding was from the large vessels running in the mucosa covering the intravesical protrusion, with the worst bleeding coming from beneath the protrusion so that the bleeding points could not be reached with a cautery or other hemostatic applications. Prostatectomy seemed to offer the only hope but the bleeding was so severe that he died before I could finish the operation and

get him back to his room. Dr. J. T. Geraghty told me that Dr. J. M. T. Finney of Baltimore had had a similar case, but that he had been able to stop the bleeding by applying a cautery to the bleeding points which, fortunately, were where they could be seen and reached with a cautery.

In no instance in my cases has the origin of the bleeding been very difficult to find except in the case which I am about to report.

Case No. 3899: W. B. S., a man aged sixty-five, married, farmer and banker, was admitted to the Piedmont Hospital July 18, 1931, with an acute appendix abscess which was so far advanced and so extensive that Dr. Floyd McRae had only to cut through the abdominal wall to permit the outflow of a large amount of pus.

Rectal examination made before the operation showed a moderate benign enlargement of the prostate, and catheterization demonstrated a small amount of residual urine, but there was no urinary infection. For several years he had observed a slight decrease in the size and force of his stream of urine with a little increased frequency. He had no history suggesting a predisposition to bleeding and his blood clotting time was three minutes and forty seconds.

After the appendix abscess was opened he was in the Hospital about forty days. Catheterization and bladder irrigations were begun about a week after operation because frequent, painful, and difficult urination developed, and continued with varying severity throughout his stay in the Hospital. The urine was found infected, with bacilli and staphylococci, about seven days after operation—at about the time catheterization was begun; before that there was no infection present. The amount of residual urine varied from 2 to 8 ounces.

He was advised, when he went home, to have his local physician keep up the catheterization and bladder irrigation at least once a day since he still had the bladder infection and varying amounts of residual urine. Catheterization, during his convalescence, had, however, been occasionally a little difficult, therefore to insure his having no difficulty with catheterization at home I gave him a catheter director with the right kind of catheters to take to his local physician.

After a few days at home his local physician tried unsuccessfully for twenty to thirty minutes (the patient says) to catheterize him without using the catheter director. The director was then tried but with doubtful success. The traumatism caused a good deal of discomfort in the prostatic region and a severe hemorrhage into the bladder which persisted for about eighteen hours, but no clots were formed which he could not pass. About three days later he came sixty miles in an automobile to see me at my office. I catheterized him without difficulty and found no blood in the urine nor any blood clots in the bladder. But the next morning the bleeding suddenly began again and grew worse during the day so that by seven o'clock that evening his bladder was full of clots and he could void only small amounts of almost pure blood. He was of course in severe pain but managed to ride sixty miles to Atlanta in an automobile.

I found about 700 to 800 c.c. of blood clots in his bladder in addition to the bloody urine. Emptying his bladder and using hot irrigations did not seem to lessen the hemorrhage. Cystoscopy disclosed nothing worth while because of the rapidity of the bleeding. During the night the bleeding continued in spite of a transfusion of 500 c.c. of blood and large doses of morphine, and the next morning the bladder had to be emptied of clots two or three times so that at about 2 P.M. I decided to open the bladder suprapubically and see what was the cause of the bleeding. I thought naturally that his hemorrhage had been caused by the catheterization, but when his bladder was opened I could find no evidence of such an injury, nor was there any visible bleeding from the bladder or urethra. All the bleeding had stopped by the time we had opened the bladder and I could find no explanation for the hemorrhage. As a precaution against further bleeding, a Pilcher bag was inserted, partially filled, and for a couple of hours pulled against the neck of the bladder; after its removal a Pezzer catheter was left in the suprapubic wound.

During the following week the patient was seemingly all right and comfortable except for an occasional sudden pain in the prostatic region which was accompanied, or immediately followed, by an urgent desire and a straining to urinate and defecate, with the passage each time of a little blood from the urethra or through the suprapubic drainage tube. These transient

and recurrent pains and spasmodic contractions were not produced by the suprapubic cystotomy or the suprapubic drainage tube for they had begun not long after the appendix abscess was first opened, and had then appeared at intervals of a few hours or a few days. They were of varying severity, but never as bad as they were just before and after the cystotomy. (They gradually grew from month to month less severe and less frequent but recurred after prostatectomy. See below.)

About the seventh day after I opened his bladder, one of the pains in the rectum and perineum, which was more severe than usual, was followed by profuse hemorrhage into the bladder and in a few hours (at 11 P.M.) I found that the bladder was full of clots, and was refilled with them every one to three hours in spite of hot rectal irrigations and *the use of a Pilcher bag*. The patient's condition went from bad to worse. He was given three transfusions each of 500 c.c. of blood, one at 3 A.M., and another one in an hour, followed at once by still another.

It had been evident then for sometime that the bleeding could not be controlled by ordinary measures, and even the pressure of the Pilcher bag seemed to be of no help. So, under spinal anesthesia, I opened the bladder very widely and made once more a thorough search for the bleeding area. I found that the bladder was slightly trabeculated and the prostate gland enlarged sufficiently to bulge somewhat into the bladder making a lower lip at the vesical orifice with some lateral lobe protrusion, but no dilated or bleeding vessels could be seen. There were, in fact, no signs of bleeding anywhere, nor any visible pathological changes from which bleeding might come. A good deal of bright red blood could be seen in the urine coming from the right ureter and for a while I thought the hemorrhages had come from the kidney, so I passed a No. 7 F. ureteral catheter up each ureter, pulled the ends through the urethra, and immediately after the operation made a pyeloureterogram, a kidney functional test, and made urine examinations which showed absolutely nothing abnormal. (Later on a cystogram showed a patent lower right ureter with filling of the right ureter.) The drainage of the urine by the ureteral catheters enabled me to put the bladder entirely at rest so it was packed quite full of vaseline gauze and only partially closed. The patient was kept quiet with large amounts of narcotics and there was very little, if any, more bleeding.

Suprapubic drainage was continued for several months and during that time the patient was carefully studied, cystourethroscopic and proctoscopic examinations were made, a barium enema given and the rectum examined with the fluoroscope and *x*-ray, but no lesion could be discovered to explain the spasmodic pains described nor a definite, demonstrable cause for the hemorrhages into the bladder. It was only after long consideration that I arrived at what I think to be an explanation of the hemorrhages:

As the result of the changes which took place about the large appendix abscess there developed, very probably, some interference with the venous circulation of the bladder and prostatic urethra. These changes must have been extensive, because, about two weeks after the abscess was first opened, lack of adequate drainage from the wound caused a well-marked swelling in the lower part of the right side of the abdomen, the right inguinal region and the upper part of the scrotum; due, no doubt, to a blocking of the lymphatic and probably of the venous drainage from those regions. The swelling disappeared rapidly when the wound was reopened and good drainage from it re-established.

As a result of this interference with the venous circulation of the bladder and urethra there was most likely an engorgement of the superficial veins in the mucosa of the bladder which lies about the bladder neck, and since the patient had a fairly large benign prostatic hypertrophy, which in my experience is usually accompanied by an enlargement of the veins in and about the mucosa which covers the protruding enlargement, it is probable that even the severe bleeding could have come from the engorged veins without the existence of a lesion which could have been discovered macroscopically once the bleeding had stopped. This supposition is borne out by the continuation of the bleeding into the bladder during the time the Pilcher bag was pulled into the prostatic urethra. (There was no bleeding from the urethra during that time.) The spasmodic pains preceding and accompanying the intermittent attacks of straining to void and to defecate may be explained by an irritability of the neck of the bladder and prostate caused by an interference with the venous circulation from those regions.

During the attacks of bleeding this straining to void was made worse by the distention of the bladder with clots and by an evident anxiety on the part of the patient. The anxiety and discomfort continued in spite of large doses of morphine. It seems to me that it was natural, if these suppositions are correct, for the bleeding to stop when complete relaxation was obtained by anesthesia—there being no gross lesion, hemorrhage ceased with relaxation just as it is so often seen to diminish during an operation under local anesthesia when an imperfect anesthesia is made complete or augmented by general anesthesia.

One year after the first hemorrhage I removed suprapubically a prostate weighing 40 grams, and the patient is alive and well.

SUMMARY

Sudden, severe hemorrhages into the unopened bladder are usually best treated by emptying the bladder of clots through suitable urethral instruments, and then using quite hot bladder irrigations. Electrical coagulation of the bleeding points is, however, sometimes necessary, and occasionally even suprapubic cystotomy. In old or anemic patients radical measures should be instituted without too much delay when the hemorrhage is not readily controlled, especially if ample facilities for blood transfusions are not available for immediate use.

In the case I report here, the patient had a hemorrhage into the bladder following an unsuccessful attempt at urethral catheterization, another one several days later, which stopped when the bladder was opened suprapubically, and another a week later which stopped when he was given a spinal anesthesia to permit reexamination of the bladder. Since no visible source of bleeding could be found at cystotomy, and since the patient had a fairly large, benign hypertrophy of the prostate, I have concluded that the hemorrhage was from the veins which run in the mucosa which covered the intravesical portion of the prostatic enlargement. These vessels are, of course, frequently enlarged in prostatic hypertrophy, and in this instance they may have been unusually engorged by an obstruction to the venous circulation of the bladder which it appears could have been caused by an extensive, acute, appendix abscess which preceded the first hemorrhage by about seven weeks. There was, also, an unexplained irritation which appeared just after the appendix abscess was opened and had produced pains in the region of the prostate resulting in spasms of straining to urinate and defecate. These recurred at varying intervals of hours or days, and in varying severity for several months, and were worse during and preceding the hemorrhages.

Subsequent examination of the urethra, bladder, rectum and abdomen showed the existence of no other changes which could account for the symptoms and the hemorrhages.

ASEPTIC URETEROINTESTINAL ANASTOMOSIS*

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CLEVELAND, O.

THE clinical results secured by transplantation of the ureters into the rectum have established the procedure as the preferred method of treatment for exstrophy of the bladder and in other cases requiring cystectomy.

Since 1851, when the first attempt at directing the urine into the rectum was made by Simon, various operations have been devised to simplify the procedure, to reduce the morbidity and to decrease the rate of mortality.

Following a series of experimental investigations upon dogs, which has been published recently, a clinical opportunity to apply this method was afforded.

CASE REPORT

A boy, aged four years, with exstrophy of the bladder was brought to the Cleveland Clinic on June 27, 1933.

History: The child had been delivered normally and, except for this congenital defect, was normal in all respects. There was nothing significant in the family history.

Physical Examination. At the mid-line just above the symyphysis was a beefy, red mass. The ureteral orifices were visible and at intervals spurts of urine could be seen coming from the ureters. The sphincter tone of the rectum seemed adequate.

Laboratory examinations showed no abnormal findings.

Operation: The child was anesthetized with ether and a small rubber tube covered with vaseline gauze was introduced into the rectum. The baby then was placed in the Trendelenburg position. A longitudinal incision was made from just above the umbilicus down to the exstrophy of the bladder. After the peritoneum was incised the intestines were displaced upward and held away from the operative field by moist tapes.

The ureters were exposed and appeared to be of normal size. A small longitudinal incision was made in the posterior peritoneum over the left ureter, which was grasped with Allis clamps. Then the ureter was drawn upward and freed from its bed by sharp dissection for approximately one inch. The point of transplantation into the rectosigmoid was selected and an incision 1½ inches long through the serosa and muscularis was made in the left lateral wall, care being taken not to enter the lumen of the bowel. Lateral separation of the serosa and muscularis provided a trough to be occupied by the transplanted ureter.

With the bowel replaced in its normal position, the exposed left ureter was so grasped that kinking and tension would be prevented when the operation was completed. The ureter was placed in the trough. A silk suture was passed through the wall and lumen of the ureter which was in contact with the mucous membrane of the bowel 1 cm. from the lower angle of the incision in the rectosigmoid (Fig. 1). The suture was carried through the mucous membrane of the rectum, the needle grasping the gauze around the rectal tube, and then was tied quite tightly, anchoring the ureter firmly to the mucous membrane of the bowel (Fig. 2). A mattress suture was used and was passed through the ureter before entering the bowel in order to avoid contamination.

The muscular and serous layers were reapproximated over the ureter with interrupted chromic catgut sutures. Following this, the posterior incised layer of peritoneum was sutured over the incision in the bowel, thus placing the suture in the bowel in a retroperitoneal position (Fig. 3).

The right ureter was transplanted by the same technique, and the abdominal incision was closed in layers without drainage.

Postoperative Course: When the patient was seen two hours after operation, urine was passing from the ureteral orifices, demonstrating that no obstruction to the ureters had occurred during the operation.

Indigocarmine was injected intravenously and appeared in normal time and in normal concentration.

* Discussed before the North Central Branch of the American Urological Association, October 26, 1932.

Two days later, urine could still be seen passing from the bowel and four days after operation, the rectal tube was removed. The silk

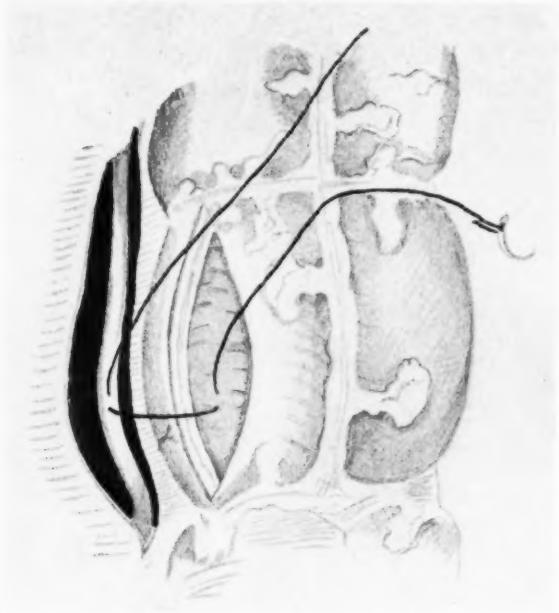

FIG. 1. Transfixion suture (mattress) between ureter and bowel, not interrupting continuity of ureter.

sutures were seen attached to the gauze surrounding the rectal tube indicating that a fistula had been established between the ureter and bowel. The urine passed freely into the rectum, while the amount coming from the ureteral orifices diminished considerably.

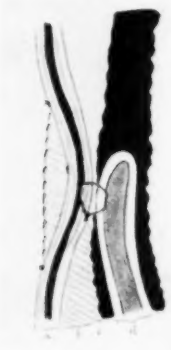

FIG. 2. Transfixion suture passing through ureter and mucous membrane of bowel and including a bite in rubber catheter.

Second Stage: Nine days later, under ether anesthesia the ureters were catheterized until resistance was met at the point at which they emerged from the trough in the bowel. A catheter was passed into the rectum, and indigocarmine injected into the ureters could be seen passing from the rectal tube.

The bladder was removed by sharp dissec-

FIG. 3. Anastomosis without interrupting of continuity of ureter, surfaces reperitonealized on opposite sides.

tion. Both ureters were easily dissected upward extraperitoneally to the points of emergence from the troughs in the bowel; they were divided between clamps and ligated with silk sutures (Fig. 5). An additional suture anchored the ureter to the bowel. The lower ends of both ureters and the bladder were removed together. The incision was closed with chromic catgut.

Postoperative Course: The patient's convalescence was uneventful and very little postoperative reaction was noted. When he was discharged ten days after the second operation, the urine was passing freely from the rectum and his general condition was excellent. Three months after operation the abdominal incision was well healed.

EXPERIMENTAL OBSERVATIONS

Experiments on dogs have shown that the establishment of ureterointestinal anastomosis without diverting the urinary stream, and without severing the continuity of the ureter until the channel is established between the ureter and bowel, is simple and is characterized by a lack of postoperative reaction.

In the experimental animals, the fistula is established between the ureter and the bowel within forty-eight to seventy-two hours. In many instances the rectal tube has not been used, but by the use of the tube, the fistula is produced ten to twelve hours earlier. This probably is due to the peristaltic action of the bowel on the rectal tube which places increased tension on the suture.

Fig. 4. Cross section showing new channel between ureter before bladder and lower portion of ureter are removed.

Fig. 5. Final stage of operation showing removal of lower portion of ureter up to point of emergence from trough in bowel and cystectomy.

As soon as the channel between the ureter and bowel forms, there is a marked diminution in the amount of urine passing from the ureteral orifices, with most of the urine passing into the rectum.

Intravenous urography is a valuable aid in following the progress of this operation. Ten to twelve hours after implantation of the ureters into the bowel, before the new channel is established between the ureter and rectum, the urogram reveals urine in the bladder with no evidence of obstruction in the urinary tract.

Forty-eight to seventy-two hours later, after the new channel has formed, the urogram shows the urine both in the rectum and in the bladder. By this means, it is possible to ascertain when the new channels are functioning and when to perform cystectomy and removal of the lower segment of the ureter.

CONCLUSIONS

1. A technique is presented for simultaneous bilateral transplantation of the ureters into the rectosigmoid. The continuity of the ureter is not interrupted until the new channel develops, and the normal physiologic function of the upper urinary tract is not altered until the anastomosis has formed.

2. Due to the simplicity of the procedure, operation may be performed on a child with exstrophy of the bladder very early, and before the development of renal complications. A case is reported of operation on a boy, aged four years, in which a most satisfactory result was secured with very slight postoperative reaction.

3. Examinations of the kidneys and ureter in dogs six months after this operation reveal no evidence of hydronephrosis or infection.

4. Experience with experimental animals has shown that peritonitis, shock, and acute renal sepsis following this procedure are reduced to a minimum.

PATENT URACHUS

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MANY interesting developmental anomolies may arise during the embryonic formation of the genito-urinary system. The primitive urogenital sinus, which has become differentiated from the cloaca by elongation and constriction, forms a dorsal vesicourethral anlage which receives the allantois and mesonephric ducts. This anlage enlarges to form the bladder and a portion of the urethra. The narrowed apex of the bladder is continuous with the allantoic stalk at the umbilicus, and is called the urachus. It persists as the fibrous ligamentum umbilicale medium. The allantois contributes nothing to the formation of the bladder or urachus.[6]

Begg[1] has made a very comprehensive study of the urachus. He concludes that it is the modified upper end of the fetal bladder. At birth, the urachus reaches the umbilicus. Shortly after birth, the bladder descends, taking the urachus with it. As the latter is pulled down, the obliterated ends of the umbilical arteries are dragged with it. The fusion of the upper portions of these fibrous cords is known as "Luschka's plexus."[8]

The urachus usually measures 8 mm. in diameter at its attachment to the bladder and tapers to 1 mm. at the apex. After careful serial sections, Begg[2] concludes that the urachus extends upward from the anterior border of the bladder, usually 5–10 mm. below the apex of the latter, for a distance of 5–5.5 cm. The upper extremity is usually 11–13 cm. distant from the umbilicus. The urachus lies between the transversalis fascia and the peritoneum and is freely movable in its lowest part. It is a musculotendinous structure and hence aids in taking up the slack during the expansion and contraction of the bladder.

Begg has demonstrated that the epithelium of the urachus persists throughout life. In about two individuals out of three, its lumen is separated from that of the bladder by a thin partition of mucous membrane. In the remainder, no partition is present and the cavities communicate.

White and Holm[8] give a very concise description of the various urachal anomalies. Aside from the more normal condition just mentioned, there may be no communication between either the bladder or umbilicus, in which case urachal cysts may form. Some of these cysts may become enlarged to enormous size. Cullen[4] reports a case in which a urachal cyst filled the entire abdomen and contained 52 liters of fluid. The lower end of the urachus may remain closed and the upper end patent. In such cases, there may be a more or less continuous discharge of mucopus from the umbilicus. The fourth and most common finding is the umbilicovesical fistula.

As already mentioned, the apex of the urinary bladder, during its differentiation from the urogenital sinus, narrows to form the urachus. In case this does not occur, the bladder remains attached to the umbilicus and a discharge of urine occurs. Begg believes this is the case in all congenital vesico-umbilical fistulae.

In the acquired type of vesicoumbilical fistula, a different mechanism obtains. If there is direct communication between the urachus and the bladder, there may be an increase in intravesical pressure sufficient to cause dilatation of the urachus. The latter enlarges and becomes filled with urine which soon tends to become purulent. If the pressure continues, as it very often does with an obstructing prostate, the pressure within the urachus may cause an extrusion of urine through the urachal wall into the surrounding tissues. In such event, the urine is confined in a space enclosed by peritoneum, transversalis fascia

and the fibrous cords already described. The urine passes toward the umbilicus and, with continued pressure, forces an opening through the floor of the umbilicus and an acquired vesicoumbilical fistula results, with a discharge of urine from the umbilicus. A clear differentiation must be made, therefore, between the congenital and the acquired vesicoumbilical fistula. In the latter case, the urachus can contribute but 3–10 cm. at the most to the formation of the lower part of the fistulous tract.

FREQUENCY AND INCIDENCE

Begg, up to 1927, found 58 cases of acquired vesicoumbilical fistula, associated with patent urachus. Thirty-nine of his patients were under six years of age and only three were over forty-five. The condition occurred twice as frequently in males. Cohn[3] reports 90 per cent of all cases to occur in males. In nearly all cases, some form of an obstruction of the urethra is found. Dailey[5] emphasizes a careful investigation of every possibility of obstruction. In children, vesical stone, congenital urethral stricture and phimosis may account for the obstruction. In adults, stone, stricture and prostatic hypertrophy should be carefully looked for.

TREATMENT

If the condition is seen in the first year of life, it is better to postpone surgery, if possible, because of the high mortality at this time; and, furthermore, these fistulae may close spontaneously. If an obstruction is found and corrected, moderate pressure by pads and adhesive straps over the umbilicus and linea alba has occasionally effected a cure. Some surgeons recommend opening the urachal tract with thorough cauterization. They report successful results in a few cases.

The urachus may be ligated at its upper extremity. This procedure is more applicable in early childhood. Cauterization of the upper portion of the tract may sometimes cure the condition. This may be accomplished by passing a small probe-pointed thermocautery directly into the canal.[3]

If the simpler methods fail, radical extirpation of the entire urachus and umbilicus must follow. Mayo dissects out the tube thoroughly. The duct is then ligated, excised and the stump inverted by a purse-string suture and a drain is left in the bladder. In case a patent urachus exists without the formation of a vesicoumbilical fistula, excision is performed in exactly the same manner.

CASE REPORT

The following case is reported because it demonstrates the early formation of a patent urachus, due to an unusual form of urinary obstruction.

J. R., aged forty-five, laborer, was first admitted to St. Mary Hospital in July, 1930, complaining of pain in the left kidney region, fever, chills and burning on urination. This condition followed a fall from a horse four weeks previously, in which the patient incurred bruises of his left back. The family and past histories were entirely negative and he gave no history of previous urinary disturbance.

Physical examination at that time was essentially negative, except for moderate tenderness over the left kidney region. The prostate was normal. The urine specimen showed 1 plus albumin and 4 plus pus cells, which were clumped. No red blood cells were found. A diagnosis of left pyelitis was made and a cystoscopic examination was performed.

A normal appearing bladder was noted; the left ureter was catheterized and 5 c.c. of 0.5 per cent silver nitrate were injected into the kidney pelvis. The infection cleared up rapidly and the temperature dropped to normal. A pyelogram was made just prior to discharge. The roentgenological interpretation was as follows: "Pyelogram of the left renal pelvis reveals a mild blunting of the superior minor calyx. This may be the result of an early hydronephrosis, but is often seen in the normal pyelogram. The remainder of the examination is negative."

The patient returned home and led an active life for the next one and one-half years, with no recurrence of urinary symptoms.

Readmission: On February 20, 1933, he was re-admitted to the Hospital, complaining that for the past year the urine had been very dark, with some bright blood present at times. Five weeks before, he experienced difficulty in starting the urinary stream. At this time, he noticed large clots of dark blood in the urine, some "as long as the little finger." The passing of these clots was attended with great pain and tenesmus.

He had experienced severe pain in the suprapubic region and noticed a fulness in this area, more marked when urinary obstruction was present. He had never noted any discharge of urine or pus from the umbilicus. He had lost 10 lb. (4.5 kg.) during the past month. His present weight was 160 lb. (72.7 kg.)

Physical examination was as follows: The temperature on admission was normal, pulse 80 beats per minute. The head was negative, except for several crowned teeth which were obviously carious. The lungs were normal. The precordial dulness was within normal limits. The heart action was regular and no murmurs were present, although the sounds were of poor quality. The peripheral arteries showed no sclerosis. There was definite tenderness over the entire lower abdomen, more marked in the suprapubic region. No mass was palpable. (The patient had just voided.) There was no tenderness to hammer percussion over the kidney areas. Rectal examination revealed a slight enlargment of the lateral lobes of the prostate. The median bar did not appear enlarged and the gland was of normal consistency. The residual urine measured 250 c.c.

FIG. 1. Anteroposterior cystogram before operation. A, patent urachus. B, bladder. C, defect made by encroachment of enlarged lateral lobes of prostate.

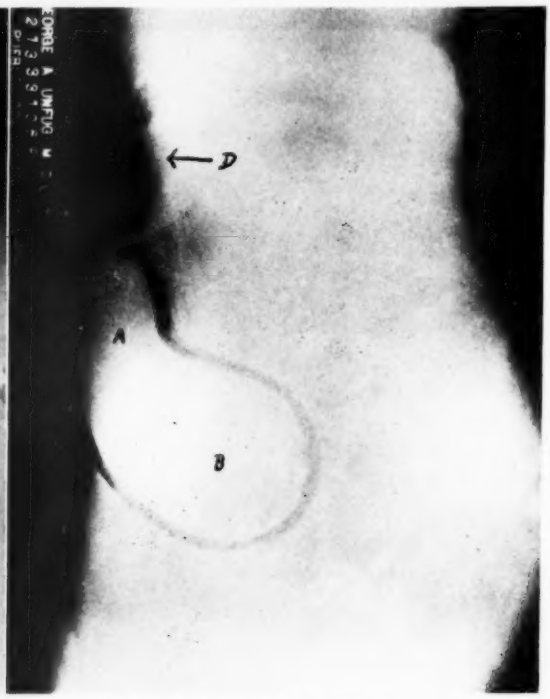

FIG. 2. Lateral cystogram before operation. A, patent urachus. B, bladder. D, Level of umbilicus.

The leucocytes numbered 5800 with a normal differential count. The erythrocytes numbered 4,100,000 with 80 per cent hemoglobin. The specific gravity of the urine was 1.017, the reaction was alkaline and it appeared very smoky. Chemical examination showed a heavy trace of albumin. The presence of clumps of pus and blood cells was detected microscopically. The Wassermann reaction was negative.

Cystoscopic Examination: At a preliminary irrigation of the bladder, a well-defined pear-shaped tumor was noticed in the suprapubic region. Its base was firmly fixed about 4 cm. above the symphysis, and its apex appeared about 6 cm. from the umbilicus. The tumor was approximately 6 cm. in length and its upper end was freely movable laterally for a distance of 2 cm. This tumor disappeared when the bladder was emptied.

Cystoscopic examination was performed with great difficulty, due to an extremely irritable

bladder. The mucosa of the bladder wall was injected with many hemorrhagic areas near the trigone. There were heavy incrustation deposits over the mucosa, which persisted after repeated irrigations and made thorough examination of the bladder difficult. Both ureteral orifices were unusually large. About 2.5 cm. below the apex of the bladder, a small depression was noted. This was interpreted to be the opening of a diverticulum and apparently was connected with the suprapubic tumor which was noted during a previous bladder irrigation.

A small tumor projected into the bladder lumen just to the left and inferior to the depression. The incrustation cystitis was so marked that definite interpretation of the nature of the growth was impossible, although a bladder papilloma was considered the most probable diagnosis.

Within a few days, cystograms were made with 7 per cent sodium iodide solution (Figs. 1 and 2). The location and nature of the bladder outpocketing suggested, at once, a patent urachus.

Operation: The patient was prepared for surgery, and operated on one week later under ether anesthesia. A vertical median incision was made extending from just below the umbilicus to the symphysis pubis. The rectus sheath was opened and the peritoneum exposed.

Fig. 3. Anteroposterior cystogram after operation. Normal appearing cystogram. No evidence of patent urachus. Defects caused by lateral lobes of prostate are now absent.

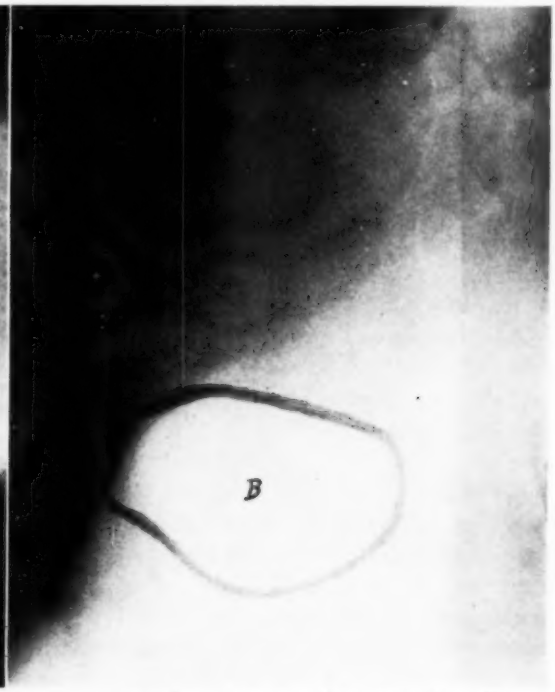

Fig. 4. Lateral cystogram after operation. Essentially normal cystogram. No evidence of patient urachus. Slight anterior protrusion presumably due to adhesions between bladder and operative scar.

Note: In lateral views (Figs. 2 and 4), bladder outline has been traced because of inability to secure enough contrast on reproductions.

By blunt and sharp dissection, the peritoneum was reflected from the filled bladder. The urachal tumor was found attached to the bladder about 3 cm. below the apex. It measured 5 cm. in length. The base was 4 cm. in diameter and tapered to the apex which had a diameter of 1 cm. From the apex, there extended a band of dense, fibrous tissue, 5 cm. in length, which was firmly connected with the umbilicus. There was considerable inflammatory tissue surrounding this band and the urachus, which made dissection extremely difficult.

The fibrous band and urachal tumor were freed, elevated and amputated respectively at the umbilicus and 0.5 cm. from the bladder wall. The point of opening into the bladder was enlarged to permit thorough exploration. A small cauliflower-like papilloma was found just superior and lateral to the left ureteral orifice. It was 2.5 cm. in length with a sessile base 1 cm. in diameter. There was a heavy deposit of

urinary salts on the tumor and several small areas of ulceration were present.

The base of the papilloma was clamped and the tumor removed with the cautery. The bladder was closed about a rubber drain, and a small wick placed down to the space of Retzius.

Pathological Diagnosis: The pathologist reported a papilloma of the bladder with some variation in size and shape of the cells. Occasional mitosis was present and the tumor was undergoing definite malignant degeneration. The inner layer of the urachus resembled very nearly the normal bladder mucosa. There was extensive round-cell infiltration with considerable edema of the wall.

Course in Hospital: The postoperative convalescence was complicated by a left pyelitis. The temperature ranged between 102° and 104°F. for nearly a week, but gradually subsided. After two weeks, the suprapubic drain was removed and an in-dwelling catheter was inserted and left in place for several days. The incision healed quickly and remained closed.

Cystoscopic examination at the time of discharge showed the bladder mucosa to be practically normal except for the presence of mild inflammation. The incrustation cystitis had disappeared. The sites of the papilloma and the patent urachus were demonstrated as two white scars. There was no residual urine and the uranalysis was normal. Cystograms taken at that time are reproduced (Figs. 3 and 4).

A cystoscopic examination six weeks after discharge from the Hospital revealed a more normal bladder mucosa and there was beginning vascularization of the scar tissue.

DISCUSSION

This case is presented because of the infrequent formation of a patent urachus due to obstruction from a bleeding papilloma. The role of obstructive lesions in the causation of this condition is emphasized. The large clots of blood from the bleeding papilloma over a period of approximately one year were sufficient to cause an obstruction of the urethra. The back pressure within the bladder gradually increased and became great enough to effect an enlargement of the normally small urachal lumen.

There was slight enlargement of the lateral lobes of the prostate, as demonstrated by rectal examination and *x*-ray (Figs. 1 and 2). We believe this was of inflammatory origin. Figure 2 shows the apparent decrease in size of these lobes two months after surgery. This was confirmed by rectal examination. The fact that the residual urine disappeared and the incision healed so promptly would seem to eliminate the prostate as an important factor in contributing to the urethral obstruction.

The cystoscopic examination of the bladder two and a half years before, revealed no papilloma or patent urachus. This again calls to mind the rapidity with which pathological changes in the genitourinary system may occur. Had the obstruction been more chronic, we believe that an acquired vesicoumbilical fistula would eventually have formed.

CONCLUSION

The acquired form of patent urachus may result from urethral obstruction caused by blood clots from a bleeding papilloma of the bladder.

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DRAINAGE AFTER URETEROINTESTINAL ANASTOMOSIS*

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WHETHER drainage should be used in connection with ureterointestinal anastomosis is a mooted question. Probably the majority of anastomoses have been made without this safeguard, with good results in the great majority of cases. But some results have been bad, and conceivably some cases with an unfortunate outcome would have resulted differently had drainage been used.

In the operation on the patient reported herewith advantage was taken of the fact that the anastomoses are made close to the posterior wall of the pelvis to drain extraperitoneally. As lateral incisions were used it was easy to strip up the peritoneum from the pelvic wall for the placement of the drains. Had the anastomoses been made through a midline incision small supplementary lateral incisions would have been necessary for the drainage.

In this case urinary leakage occurred after one of the operations; it was adequately cared for by the drainage provided. The method is reported with the thought that it may be useful to those who would like to use drainage were it not for the fear of causing troublesome adhesions.

REPORT OF CASE

A. W., a white girl of eleven years, was admitted to the Urological Service of the Hospital of the University of Pennsylvania May 16, 1932, because of exstrophy of the bladder. An operation done elsewhere seven years previously had resulted in a bridge of skin across the bladder and extensive scarring of the abdominal wall. There was no urinary control.

She was operated upon June 1, Coffey's No. 3 technique being selected as the method of anastomosis. In both this and the succeeding operation, done June 20, lateral muscle-splitting incisions were used (Fig. 1). So far as the anastomoses are concerned the technique used was identical, except that the fistulizing suture of double silk was tied more tightly on the left side than on the right. At the conclusion of each operation the peritoneum was stripped from the pelvic wall and a cigarette drain was led down through the extraperitoneal space thus made to the site of the anastomosis (Fig. 2). The outer edge of the peritoneum, where it had been cut to expose the ureter, was then drawn medially, across the anastomosis, and fastened to the gut with a single catgut stitch. The anterior incision in the peritoneum was completely sutured. The drain was brought out through the outer upper end of the musculocutaneous incision, lateral to the peritoneum.

After the first operation urine appeared in a stool on the fifth day. During the first six days her highest temperature was 100°F., but on the seventh day it rose rapidly to 104°F. and was irregular for a week thereafter, presumably due to pyelonephritis. On June 19, the eighteenth postoperative day, in a two-hour period after intramuscular injection of 'phthalein 30 per cent was recovered from the bowel and 25 per cent from the bladder (left kidney).

After the second operation, done June 20, fistulization probably occurred within twenty-four hours. Febrile reaction appeared early: second day 102°F.; third day 103°F.; fourth day 102°F.; seventh day 104°F.; ninth day 102°F.

From the seventh to the tenth day a small amount of urine escaped through the drainage tract provided extraperitoneally. At no time was there evidence of peritoneal irritation.

'Phthalein excretion on the twelfth day was estimated to be 35 per cent. (Complete emptying of the bowel may not have been accomplished. A urographic study with neoiopax showed that urine ascended as far as the cecum.)

She was discharged from the hospital July 17, and has not yet returned for follow-up examination. However, a letter from her mother written in September stated she had gained in

* From the Urological Service, Hospital of the University of Pennsylvania. Presented to the Clinical Society of Genito-Urinary Surgeons, Philadelphia, Oct. 28, 1932.

strength and weight (8 pounds), was comfortable, voiding at night once or not at all, and during the day about every two hours.

FIG. 1. Condition after second anastomosis, showing location of incisions. Result of operation previously performed is also shown.

Note. This patient reported for follow-up examination last July. Her general health had been so good through the winter that she had missed going to school but one day. She voided at two hour intervals during the day, and not more than once at night. Occasionally very sound sleep resulted in incontinence. 'Phthalein excretion was estimated to be 15 per cent during the first hour, and 13 per cent during the second (intramuscular injection).

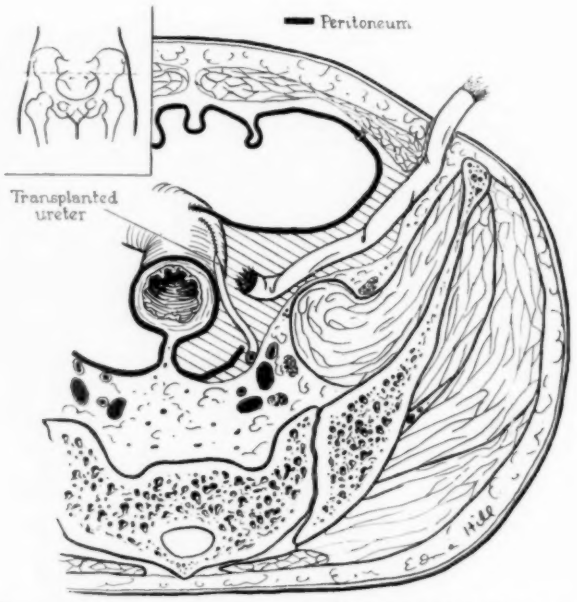

FIG. 2. Schematic transverse section of pelvis showing arrangement of drain.

Urography showed somewhat more dilatation of ureters and pelves than at examination shortly after operation.

HISTORICAL DATA ON URETERAL TRANSPLANTATION

(PETERS' OPERATION)*

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THE early history of ureteral transplantation into the bowel is linked closely with that of the treatment of exstrophy of the bladder. The pitiable condition of unfortunate patients born with exstrophy of the bladder and the failure of plastic operations on the bladder itself in these cases, were the stimulus for the early attempts to bring about a cloacal condition by diverting the ureteral urine into the bowel. The development of this surgical procedure has been reviewed quite thoroughly by Buchanan, Stevens, C. H. Mayo, Coffey and others. My object is to bring before you some of the late results of operations performed prior to the development of the surgical valve principle devised by Coffey and C. H. Mayo and generally accepted by present-day surgeons doing ureteral transplantation.

Many unsuccessful or only partially successful operations were done during the latter part of the nineteenth century, but the first real advance in ureteroenterostomy was made by Mandyl in 1894, when he transplanted the trigone of the bladder with the ureters into the sigmoid colon, by a transperitoneal method. He realized the dangers of ascending infection and aimed to avoid it by retaining the natural protecting mechanism of the ureterovesical junction. His results were superior to those of any other surgeon up to that time, but many of his patients died of general peritonitis. Buchanan's compilation of cases operated on by the Mandyl method was brought up to date in 1916 by Stevens, who found that the immediate mortality was 28.1 per cent.

In 1896, Bergenhem transplanted the ureters separately into the rectum extraperitoneally. A similar operation was performed independently by Peters in 1899 and published in 1901. Many surgeons in the English speaking world took up this method of operation and to most of us the operation is known as the Peters' operation.

In this operation its originator also aimed at retaining the valve action of the entrance of the ureter into the bladder by saving a rosette of bladder wall about the meatus, which was carried into the lumen of the bowel. Though recognizing the danger of ascending infection, he failed to appreciate the physics of the action of the valve which he retained.

Peters operated on five children by this method between 1899 and his untimely death in 1906. It was my good fortune to follow the fifth of these patients for the last six years of his life. This case has already been reported in detail. Therefore, I shall only review it briefly.

G. R. was operated upon on January 24, 1905, when four years old, both ureters being transplanted into the rectum by the extraperitoneal method. He made a rather slow recovery but left the hospital in good condition on April 24, 1905. Afterwards he attended school from the age of seven, until he was fourteen years old. He later worked as a messenger boy, afterwards for one year made his living wrapping parcels, and for the last ten years worked as a lather.

On December 6, 1924, he was admitted to St. Michael's Hospital under my care with a right-sided calculus pyonephrosis and perinephritic abscess. Both were drained and the stones removed. The fistula healed promptly. He was married soon after this and carried on his work as a lather until a fortnight before he returned to the hospital again.

He was admitted for the second time on February 12, 1931, giving a history of left-

* Read before the North Central Branch of the American Urological Association, Detroit, October 27, 1932.

sided pain for seventeen days, with the passage of a stone 1.5 × 1 cm. in size, from the left ureter by bowel. The passage of the stone did not completely relieve the pain and his general condition became steadily worse. On entering the hospital he was in a mild degree of shock; the blood urea nitrogen was 83.7 mg. per 100 c.c. of blood. There was tenderness and rigidity in the left lower quadrant of the abdomen extending to the left flank.

On exploratory operation it was found that there had been extravasation of urine from the lower end of the left ureter. The area was drained. He died on February 14, 1931, over twenty-six years after his original operation.

Since observing this patient, 4 others who were operated on by the same method long ago have been brought to my attention and are briefly summarized as follows:

1. C. S., a patient of Dr. F. N. G. Starr. On May 11, 1907, Starr transplanted both ureters into the rectum because of exstrophy of the bladder. The boy at that time was eleven years old and had had three unsuccessful plastic operations performed on the bladder by a well-known surgeon in another city. A few days after the ureteral transplantation, one ureter slipped out of the bowel and required re-implantation on June 4, 1907. Recovery was uneventful. On September 15, 1916, the bladder was ablated and the raw surface covered with a flap graft. He was seen by Starr in 1926, when he was fitted with a truss for a small inguinal hernia. His father, a practising physician in New York State, reports on September 9, 1932, over twenty-five years after the operation, as follows, "He has enjoyed remarkably good health, no sickness attributable to the ureter transplantation, can retain urine from one to six hours. His condition has not interfered materially with his work as a travelling salesman for the past fifteen years."

2. T. P., a boy sixteen years old, suffering from ectopia vesicae, was operated upon by Coleridge on January 21, 1910, by the extraperitoneal method. He made an uneventful recovery. Dr. C. C. Cornish of Ingersoll, Ontario, reports regarding his after history as follows: "I attended him at intervals since 1914 for minor complaints, but at no time did he present any symptoms referable to the urinary system. His fatal illness was a bronchopneumonia, following an attack of influenza last winter. He enjoyed exceptionally good health and did all kinds of heavy work."

To Professor J. H. Fisher of the University of Western Ontario, I am indebted for notes of his final illness and autopsy findings. He was admitted to the Victoria Hospital, London, on March 24, 1932, suffering from bilateral pneumonia and co-existing uremia. The systolic blood pressure was 154 and the diastolic 60. Examination of the urine showed: alkaline reaction; specific gravity 1.017; albumin 2 plus, and abundant pus was found on microscopic examination. The non-protein nitrogen was 91.0 mg. per 100 c.c. of blood.

He died on March 27, 1932 and at autopsy both kidneys were found to be small with dilated calyces and marked thinning of the cortex. Both ureters were dilated and elongated. On examination the opening of the ureters into the bowel, they were found to be very much dilated.

3. Dr. A. R. Stevens reported the case of a boy, aged sixteen, operated upon by this method in April, 1911. This boy left the hospital on June 15, 1911, voiding at intervals of two to six hours.

This patient was examined on April 21, 1932, by Dr. Stevens, when the following observations were made: "The patient is a very small individual but seems to be in as good health as ever. He has excellent control of his urine day and night under ordinary circumstances. He has tried to operate a taxicab and found that the prolonged periods of bumping caused him to get a little wet. He urinates every three to five hours, usually five times during the day and from 0 to 1 at night. A phthalein test given intravenously was reported as follows, for half hour periods; 1st, 15 per cent; 2nd, 15 per cent; 3rd, 5 per cent, and 4th not measurable."

4. Green Armytage has reported the case of a woman on whom he performed this operation at the age of fourteen years in 1912. She made an uneventful recovery and in 1926 returned to his care, at which time a Cesarean section was successfully carried out.

In 1916 Stevens reviewed the results of this type of operation, giving the credit to Bergenhem, who first reported it. He found that in the collected series the immediate mortality was 11.5 per cent as compared

with 28 per cent for the Mandyl operation. At that time 21.4 per cent of the reported cases had lived over five years. Though I have no intention of recommending this older operation as superior to the modern operation devised by Coffey, employing the principle of surgical valve formation, the operation has merit. Four of the patients reported lived for over twenty-one years after the transplantation was done, and two are still alive and enjoying good health twenty-five and twenty-two years after operation. The low level in the bowel at which the transplant was made may well be a factor in the continued good health of these patients; the urine being retained in that portion of the lower bowel from which absorption does not take place. In children the extraperitoneal approach is not difficult and it would appear that the merits of this method might in some cases be combined with Coffey's valve method, thus avoiding the dangers of the intraperitoneal approach.

I wish to thank Dr. F. N. G. Starr of Toronto, Dr. C. C. Cornish of Ingersoll, Dr. J. H. Fisher of London and Dr. A. R. Stevens of New York, for the data which they have provided and for their kind permission to report the late results of these cases.

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CONGENITAL PELVIC KIDNEY

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CONGENITAL pelvic kidney may be considered one of the rarer developmental anomalies. Gerard estimates its occurrence as 1 in 2500 autopsies. However since pathological conditions are found more frequently in such anomalies they assume a place of much more importance than would be inferred from their incidence. Many case reports appear in the literature. These have been collected and reported along with various other kidney anomalies. However no summary seems to have been made of the pathological conditions which may arise in these anomalies nor any correlation of appropriate methods for operative approach.

In addition to the report of a case it seems worth while to note certain pathological changes which are prone to occur with reference to the more important anomalies of blood supply and methods of operative approach.

H. S. male, aged thirty-four, an accountant, was referred for the removal of a ureteral stone. The family history was unimportant and his habits were normal. Five years ago he had had three attacks of right renal colic over a period of ten days associated with some dysuria and frequency. The pain was low on the right side, lasting from one to three hours and was relieved somewhat by hypodermic injections. Hematuria was present during the first attack. Roentgenograms were taken and a diagnosis of ureteral stone was made. Three days later he was operated on for a stone in the right ureter. The patient stated that the stone was not obtained, that he was in the hospital six weeks and a ureteral catheter had to be inserted which was retained for ten days. For the past year the patient states that he has suffered from lack of energy and weakness but has had no pain on the right side, dysuria or frequency.

On *examination*, the heart and lungs were found normal and no masses could be felt in the abdomen. The genitals were normal, except for the right testicle which was absent from the scrotum. This however was found in the inguinal region, apparently an undescended testicle. The blood was normal, the Wassermann reaction negative. The centrifuged urine was negative for pus and blood. A phenolsulphonphthalein test (one hour intravenously) showed a return of 60 per cent. After oil and enema preparation a roentgenogram of the kidneys, ureters and bladder showed the presence of a shadow 1.5 by 2.5 cm. over the sacroiliac synchondrosis. The shadow apparently lay slightly transversely instead of occupying the usual vertical position. Because of the abnormal position of the stone with respect to its long axis and the history of a previous operation, the stone not being obtained, pyelography was carried out. Indigocarmine appeared in three minutes from the left and was graded 4. On the right a fair blue appeared in four minutes and spurts were observed on this side for ten minutes. This kidney function was graded 2. A No. 5 ureteral catheter was passed on the left without difficulty. On the right obstruction was met with about 7 cm. from the right meatus. One cubic centimeter of phenolsulphonphthalein dye was injected intravenously. On the left the dye appeared in three minutes, and on the right in three and one-half minutes. A fifteen minute specimen showed 20 per cent from the left kidney and 10 per cent from the right. A right pyelogram revealed a congenital pelvic kidney, the pelvis of which included the shadow previously seen in the *x*-ray of the entire tract. A diagnosis was made of right congenital pelvic kidney containing a stone 2.5 by 3.5 cm.

Since there was no infection and 60 per cent function, and since there had been no history of obstruction from the stone during the past four years, operation was not urged.

"Pelvic kidney" is used to denote that form of kidney dystopia in which the organ is situated wholly or in part within the pelvis. "Congenital pelvic kidney" is used to differentiate between the "floating kidney" and the true congenital variety

with its anomalous blood supply and short ureter. More frequently the kidney lies obliquely across the sacroiliac synchrondrosis or across the sacral promontory. In the female it may lie behind the uterus or transversely between the uterus and bladder. The kidney has usually failed to rotate. The ureter, much shorter than normal, arises anteriorly and after a tortuous course enters the bladder in the normal position.

Fig. 1.

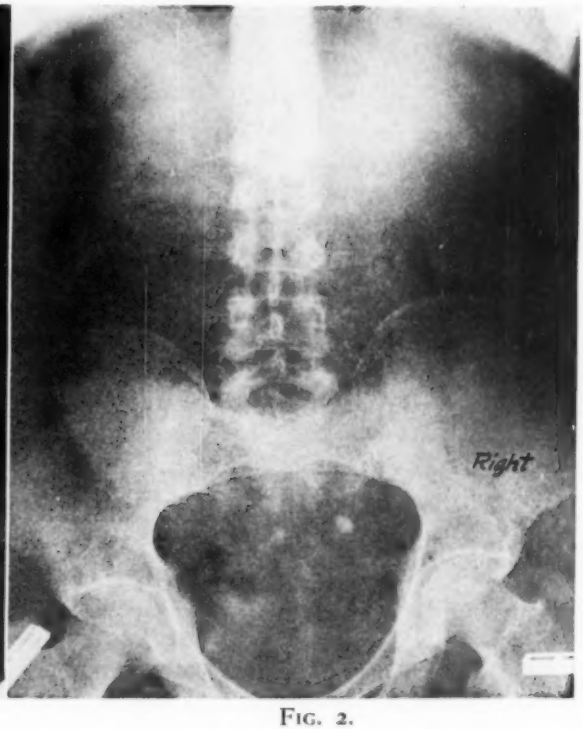

Fig. 2.

The suprarenal gland is always found in its normal position. Gilman states that among the several hundred developmentally displaced kidneys not one of these cases describes the adrenal gland as being out of its normal developmental position.

Congenital pelvic kidney is frequently associated with genital anomalies and Quizzetti suggests that where genital anomalies are found a congenital pelvic kidney should always be suspected.

The anomaly has been recognized from the earliest times, many case reports and collections appear in the literature. On reviewing these it is found however that many anomalies other than cases of true congenital pelvic kidneys have been included. Of the 122 cases collected and reported by Dorland, only 22 are of the true congenital type.

I have reviewed the reports of 52 cases which can be accepted as true congenital pelvic kidney. For various reasons only 32 of these have been accepted for comparison and study. Only those cases have been accepted which lie wholly or in part within the true pelvis.

It is interesting to note that by far the greater number of these anomalies occur on the left side. Of the 32 cases 24 were found on the left side, and 8 on the right.

Many of the anomalies have been discovered accidently at autopsy, the patient having died from causes unrelated to the kidneys. In this group 12 cases were discovered at autopsy. In 8 there were no symptoms referable to the genitourinary tract. Occasionally during pelvic examinations the kidney is felt posterior to the uterus. At first one may think he is dealing with a pelvic tumor. Differential diagnosis is only possible by cystoscopy.

Five cases have been discovered during labor. Cragin concluded that when present in married women it may cause dystocia

which is extreme. He recommends the induction of early labor or cesarian section.

Occasionally the ectopic organ is a solitary kidney. In a recent paper Harrington reports a case in which during an abdominal operation a pelvic kidney was found on the left side. The pelvic organ was a solitary kidney in 4 of this series.

The blood supply is always anomalous and is best understood by a consideration of its development.

In an embryo of 7 mm. the kidneys lie at the level of the second sacral vertebra. During the next three months they must ascend to their normal position in the lumbar region when they receive the vascularization. This is about the third month of fetal life. Ascent and rotation may stop at any point and in such case the blood supply is obtained from the nearest artery of sufficient size.

In 20 cases of this series in which the blood supply was well described a single artery to the pelvic kidney was found in 10; which sprang from the aorta near its bifurcation in 4, from the common iliac in 3, and the hypogastric in 3. Two arteries were found in 6; which sprang from the hypogastric alone in 2, the aorta and common iliac in 2 and the aorta and hypogastric in 2. In 1 case there were three arteries all arising from the aorta near its bifurcation. In one there were three all arising from the common iliac. In one there were four, three arising from the aorta and one from the hypogastric. The venous supply as a rule corresponds to the arterial, but occasionally may be quite different as in the case reported by Dorland in which there were two arteries, one arising from the aorta near its bifurcation and one from the common iliac. The venous return was by two veins, both of which emptied into the common iliac.

Transperitoneal nephrectomy was performed 8 times in this group with 2 deaths, vaginal nephrectomy once with recovery. Bevan reports the removal of two stones from the pelvis of a pelvic kidney by the extraperitoneal route. A McBurney type of incision was used; the kidney was not drained. He reports no difficulty encountered in this operation. However the exact position of the dystopic organ was not clearly stated and it is possible that he may have been dealing with a kidney located in the sigmoid region. Murphy reports the removal of stones three times over a period of eight years in the same patient. This was accomplished in the first two operations by fixing the anterior peritoneum to the kidney pelvis by continuous suture. At the third operation the kidney was found more or less fixed to the anterior peritoneum. A pack was inserted and in ten days the pelvis was incised and the stones removed.

COMMENT

A case of congenital pelvic kidney containing a stone has been described, and a brief review of the literature made. The different forms of operative approach have been discussed. A pyelogram should be done in any case of unexplained unilateral pain to rule out anomalies of the urinary tract. This case well illustrates the advisability of preoperative pyeloureterograms in all cases where a stone is thought to be included in the pelvis of a kidney or in the ureter.

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PERINEPHRITIC ABSCESS

CONFUSED WITH ADJACENT OSSEOUS LESIONS*

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FROM a standpoint of early diagnosis perinephritic abscess is one of the most confusing entities for the reason that this condition is often complicated by lack of positive findings and by the presence of adjacent pathological lesions giving signs and symptoms similar or almost identical with those of such an abscess. This report is made to emphasize one of these factors, namely bone lesions in this area.

Of 81 suspected cases of perinephritic abscess reviewed, 37 proved to be such either at operation or necropsy. In 3 of the remainder surgery revealed a bony lesion instead of the suspected perirenal abscess.

Preoperative diagnosis of an abscess around the kidney is based upon the following signs and symptoms: pain and tenderness in the costovertebral angle, fever, leucocytosis and positive *x*-ray deviations. Other less important findings may be present, such as fixity and slight flexion of the thigh due to reflex contracture of the psoas magnus from irritation, lateral curvature of the spine away from the involved side, and the presence of staphylococci with only a few or no pus cells in the urine.

Advanced cases predominate in public institutions. These do not prove especially difficult to diagnose in contradistinction to those earlier abscesses or suppurative conditions usually observed in private practice, in which the honeycombed fat has not entirely broken down.

The most common site of the abscess is posterior to the kidney with a downward extension. In children it is apt to be high up toward the median line. If pus collects near the upper pole, symptoms will be similar to those of a subphrenic abscess and the diaphragmatic excursion is apt to be considerably limited. Pleurisy, empyema and even lung abscess may result by extension of the inflammatory process. Figure 1 illustrates such a case, in which bismuth paste injected into the perinephritic sinus was coughed up through the bronchus. The roentgenological studies were disappointing because of the frequent absence of positive or helpful findings. Stereoscopic pictures as recommended by Peacock help in that they may show the kidney displaced anteriorly or laterally by the abscess.

Pain is generally localized over the kidney region; however, it may occur at a distance, especially in the inferior quadrants of the abdomen. The rigidity of the abdominal muscles in children is most frequently due to fear. In adults these muscles are relaxed unless the abscess is large, extends anteriorly or has perforated into the abdominal cavity. An advanced condition is accompanied by rigidity of the lumbar muscles and in an occasional case a large abscess may show fluctuation. Symptoms of nausea or vomiting are the results of tension on the kidney pedicle, toxicity, peritoneal irritation or rarely back pressure in the renal pelvis when associated with ureteral obstruction.

Except for the presence of staphylococci negative urinary findings are the rule when the renal parenchyma is not involved. With few exceptions this organism predominates in these infections. Trauma, although often cited as antedating the abscess, is only an incident in the course of the disease. The presence of furuncles, pustular acne, paronychia, cutaneous abrasions or other superficial foci of infection

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are of assistance in establishing the diagnosis.

The difficulty in establishing a conclusive preoperative diagnosis is emphasized by the fact that abscesses in this region have been found which lacked the classical signs and symptoms of such a condition. Where the majority of signs and symptoms of perinephritic abscess are present and other pathological conditions have been reasonably excluded, surgical exploration is justified. The end results without drainage are exceedingly serious, but when early drainage is instituted a cure is the rule.

Fig. 1. Perinephritic sinus injected with bismuth paste, coughed up through bronchus.

In the differential diagnosis of perinephritic abscess, involvement of bony structures adjacent to the kidney must always be considered. The signs and symptoms in both instances are those of a deep suppuration and the predominant *x*-ray findings are negative in both.

The 3 cases here presented were all suspected of being perinephritic abscess. The primary lesion, however, proved to be suppuration of nearby bony structures without involvement of the true perirenal space. They illustrate the difficulty and confusion which may result when such a condition exists.

Fig. 2. Sinus injected with lipiodol and leading to tenth rib, showing osteomyelitis.

Case 1. Hospital No. 233–740. A boy twelve years of age presented himself at the Los Angeles General Hospital on August 16, 1932 complaining of pain over the left loin, swelling in this region, fever, anorexia and nausea. For the past month he had had a series of boils about the face and trunk. Three weeks ago he had fallen and sustained a bruise in the region of the left kidney. Twelve days before entry he developed a cough and fever which persisted for three or four days. Following this he felt unusually well up to two days before entry when he complained of having strained his left side while playing ball. Fever, malaise, anorexia and severe pain in the left loin promptly ensued. On the day of entry the mother had noted a tender swelling in the painful region. She consulted a physician who referred her to the hospital. Just before arriving the patient vomited considerable bile-tinged material.

Past History: He had had pneumonia twice, measles and smallpox all within the past five years. The family history was irrelevant.

Examination revealed a fairly well-nourished, well-developed boy lying on his back with thighs flexed. A purulent bloody drainage exuded from a small furuncle located over the right frontal prominence. The nasopharynx was hyperemic. There was a rounded, tender, non-fluctuant swelling extending over the left lower ribs posteriorly and laterally and downward to just above the iliac crest. Tenderness was most marked over the costovertebral angle. The chest was otherwise normal. Voluntary rigidity of the abdominal muscles precluded a satisfactory examination of the abdomen. Hyperextension and internal rotation of the left thigh did not produce discomfort.

The temperature on admission was 101.8°F., pulse 132, respiration 24 and blood pressure 138/92. Blood count showed 30,000 leucocytes of which 89 per cent were polymorphonuclears; red blood cells were 4,390,00 with 85 per cent hemoglobin. Phenolsulphonphthalein intravenously appeared in thirteen minutes and 50 per cent was excreted within the first half hour thereafter. Urinalysis showed a few pus cells, an occasional red blood cell and a few gram positive cocci. Non-protein nitrogen of the blood was 31. A flat *x*-ray plate of the abdomen showed the kidney outlines and the margins of the psoas muscles obscured by a large amount of intestinal gas; the diaphragm was in its normal position.

Diagnosis: Left perinephritic abscess.

Operation: Surgical exploration carried out on August 17, 1932. Through a short hockey-stick incision the kidney was completely mobilized and the diaphragm, kidney fossa and spinal column were carefully explored. No suppuration was found.

Course: X-ray of the chest taken the day following surgery showed some haziness and increased density over the left thorax, suggestive of a small accumulation of fluid at the base. Thoracentesis was done and 5 c.c. of opalescent fluid aspirated. Examination of this showed a large number of pus cells but no organism.

For five days following operation there was some improvement. Pain, tenderness and fever decreased. Laboratory data obtained during this interval showed a positive blood culture for Staphylococcus aureus, blood sugar of 107, negative blood Wassermann and Kahn reactions, and a leucocytosis of 28,900.

On August 23 the temperature rose again, pain and tenderness increased and during the next eight days the swelling over the lower left ribs posteriorly, previously noted, became fluctuant. The mass was incised and approximately 300 c.c. of thick pus containing Staphylococcus aureus were recovered. Following drainage the abscess cavity was injected with lipiodol and *x*-rays demonstrated a sinus leading from the point of incision to a zone of localized bone destruction and periosteal proliferation in the lateral portion of the tenth rib, characteristic of osteomyelitis. (See Fig. 2.)

After an interval of three weeks the necrotic portion of this rib was resected. The patient was discharged from the hospital on October 11, in good condition.

Here we have the preoperative picture of a tender area in the left costovertebral angle and the lower chest, fever, polymorphonuclear leucocytosis and a history of a series of furuncles. There was bulging in the loin. The urine showed a small number of pus cells and a few gram-positive cocci arranged in groups. Other than a soft tissue swelling, the roentgenogram was essentially negative. The dome of the diaphragm and the psoas outline were observed. Exploration of the kidney fossa seemed indicated and was done. Since surgery and repeated *x*-ray studies did not establish a diagnosis, no further progress was made until an area of cellulitis and fluctuation appeared over the costal margin in the anterior axillary line of the left chest. Then an *x*-ray study showed an osteomyelitis of the left tenth rib.

Case II. Hospital No. P. F. 156–400. An eighteen-year-old American school boy presented himself in April, 1931, complaining of pain in the left loin of two weeks' duration. This pain began while playing ball and was sharp at the outset and constant since, radiating downward into the testicle. Muscular effort aggravated it. There were no chills or urinary symptoms. He had had mumps four weeks before the onset of the present illness.

Examination revealed moderate tenderness and muscular rigidity in the left costovertebral angle. Temperature was irregular and septic in type ranging from 98° to 103.6°F. The urine contained gram-positive cocci in groups and singly. There was a polymorphonuclear leuco-

cytosis. A flat *x*-ray plate of the abdomen showed obliteration of the left kidney shadow and psoas margin.

Diagnosis: Perinephritic abscess.

Operation: The left kidney region explored through a classical kidney incision. The kidney and perinephritic tissue appeared normal, but a large abscess was found posterior to the lumbar fascia, which was incised and drained. Smear and culture of the pus showed Staphylococcus aureus.

Because of persistent drainage from the wound a kidney study was performed five weeks after operation. Pus and gram-negative bacilli were recovered from both kidney pelves. *X*-rays taken of this region six weeks after operation showed erosion of the margins of the first and second lumbar vertebrae anteriorly, with localized destruction of the intervertebral disc. Recovery was complete.

Although primary osteomyelitis of the vertebra is rare it is more frequently found than osteomyelitis of the rib. In January, 1932, Lazarus reported 2 cases of this condition simulating perinephritic abscess.

Case III. Hospital No. 183–619. A twenty-five year old American housewife entered the hospital in October, 1931 with a history of recurring boils of the face and neck. Five days before entry she was taken suddenly ill with a pain in the right loin. This was followed by chills, fever, night sweats and anorexia. The pain was fairly constant and radiated downward into the thigh. Flexion relieved it.

Examination revealed a well-developed female showing slight emaciation. There was extreme tenderness in the right costovertebral angle with a suggestion of a mass there. The temperature was high and septic in type. Leucocytosis was marked with a predominance of polymorphonuclear cells. The urine contained a few pus cells and gram-negative bacilli. The first *x*-ray plate of the abdomen, taken soon after admission, showed obliteration of the kidney shadows and psoas margins.

A *tentative diagnosis* of perinephritic abscess was made but surgery was postponed in favor of further study.

Course: *X*-rays repeated one week after admission showed erosion of the articular process between the third and fourth lumbar vertebrae. Eighteen days after entrance a fluctuant mass was obvious on palpation situated over the right psoas muscle at the level of the second and third vertebrae. This was drained through a vertical incision in the right paravertebral line. Staphylococcus aureus was demonstrated in the pus. Guinea-pig inoculation was negative for tubercle bacilli. The spine was the origin of this suppurative process.

CONCLUSIONS

1. Pathological processes presenting practically all the signs and symptoms of perinephritic abscess may lie entirely outside the kidney fossa.

2. Early accurate diagnosis in such cases with our present procedures is hardly to be expected.

3. When surgical exploration for perinephritic abscess is unsuccessful a careful consideration and diagnostic investigation of all structures adjacent to the kidney should be made.

4. Suppuration in this region of structures other than the kidney and perinephritic fat have the same etiological background, viz., hematogenous infection from foci of suppuration elsewhere, and such cases occur with sufficient frequency to warrant their consideration in cases of suspected perinephritic abscess.

DISCUSSION

Dr. Robert V. Day: Notwithstanding the rarity of primary osteomyelitis of rib or vertebra adjacent to the renal region and producing signs and symptoms resembling perinephritic abscess, it is important that such conditions be carefully reported because they are apt to lead to great confusion in diagnosis and subsequent treatment. Appraisal of the nature and manifestations of such lesions will cause one to consider carefully the possibility of its presence.

Dr. Philip Stephens: These cases present an interesting problem of rare bone lesions simulating a relatively common kidney lesion. In both instances the origin usually is from a septic focus. The early symptoms are characteristic of generalized septic infection and even the later localizing signs are not definite. In retrospect, we might be better able to differentiate these cases if we would pay special attention to palpation directly along the line of the ribs for periosteal tenderness, and in the young person with an abnormal amount of early psoas involvement and pain on lateral and forward bending we should suspect bone pathology in the spine rather than in the soft tissues about the kidney.

RENAL INFARCTS

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TRAUBE[1] reported the first proved clinical case of renal infarct and Aschner[2] collected from the literature and discussed in detail a group of 16 clinical cases, to which he added 2, in one of which the diagnosis was questionable. Falci[3] and Danhiez[4] describe in great detail infarction of the kidney with respect to genesis, pathologic anatomy, symptoms and treatment. Barney and Mintz[5] studied the autopsy records of 143 cases and conclude that "this study warrants the opinion that no rule can be laid down as to definite diagnostic symptoms, except to say that in many instances a complete lack of symptoms and signs pointing to the kidney may make it impossible to detect renal infarcts." The following case seems of sufficient interest to merit report.

A man, aged fifty-four, carpenter, was admitted to Bethany Hospital February 13, 1932, with a grasping constricting, burning sensation of pain in the "pit of the stomach" without appreciable radiation.

Family History: His father died of paralysis at the age of seventy-two; the mother, of diabetes, aged seventy-six; one sister, of cancer, age unknown; one brother and one sister are living and well.

Past History: About two years ago the patient had an attack of pain similar in character to the present attack. He was hospitalized and numerous roentgenograms taken. Improvement took place, but the details of treatment are not available and after eleven days he was discharged.

About three weeks ago (January, 1932) a similar attack occurred. It was described as a grasping, constricting, burning pain, relieved for the time by alkalies on February 12, 1932, at which time there came on "terrific cramps" in the pit of the stomach and left renal region, gradually increasing in severity, and partially relieved by morphine sulphate.

Examination: The patient was well developed, well nourished and in acute pain. The chest was normal except for occasional sibilant râles posteriorly. The blood pressure was 130 systolic, 70 diastolic. The temperature on entrance was 98.8°F., pulse 90, respiration 24. Erythrocytes 5,070,000, hemoglobin 94 per cent Sahli; leucocytes 17,800, polymorphonuclears, 83 per cent, small lymphocytes 8 per cent, large lymphocytes 1 per cent, large mononuclears, 8 per cent. Wassermann test of blood was negative; blood nitrogen 28 mg., creatinine 2.1 mg. No blood cultures were made. Urine, sp. gv. 1.032, trace of albumin; the microscopic sediment consisted chiefly of amorphous urates.

There were marked tenderness and acute pain of palpation of upper left epigastrium and excruciating pain on deep pressure in the left renal region. There was considerable temporary lordosis to the left. There was board-like rigidity of the left lumbar muscles and it was thought that a mass could be palpated in the left renal region.

A barium study of the alimentary tract and visualization of the gall bladder were negative. On cystoscopy with bilateral ureteral catheterization, the right catheter passed easily to the renal pelvis and the urine thus collected was normal; the left catheter met with definite obstruction about 3 cm. from the orifice and no urine could be obtained. Attempts at retrograde pyelography were futile, the pyelographic medium refusing to go up higher than the left catheter. Intravenous urography revealed marked impairment of the function of the left kidney, the substance of which appeared dense, showing the lack of secretory power. The right kidney was seen to be secreting five minutes after administration of the dye.

Operation: In the meantime the patient's condition became worse and left nephrectomy was advised. Through a left lumbar incision, marked perirenal adhesions were encountered. The left kidney was large, the cortex of a dull, red color, somewhat mottled. On clamping and ligation, the renal vessels seemed sclerotic and there was little bleeding. The left ureter was a thin, white fibrous cord and had no lumen. No perirenal abscess was found. Two

cigarette drains were inserted and the wound closed by layers.

For four days, the postoperative course was stormy. There was little discharge from the wound and the drains were removed on the seventh day. The patient left the hospital on the tenth day after operation with all symptoms apparently relieved.

The *pathological report* follows: The kidney was twice the normal size, tense and markedly mottled. The capsule stripped easily leaving a granular surface on which were outlined various sized and shaped infarcts. On hemisection, the infarcted areas involved mainly the cortex. The vessels were sclerotic, thickened, and contained many small thrombi. Paraffin sections stained with hematoxylin and eosin of typical areas showed marked and complete degenerative changes in all tubular and glomerular structures in the infarcted areas, with small thrombi in the vessels.

Course: The patient soon returned to light normal labor as a carpenter. Three and one-half months after operation, he was seized with a severe pain in the chest at 3 A.M. (June 14, 1932), cramps, profuse perspiration and died before medical aid could be given. The coroner's autopsy revealed a large, obliterating thrombus in the anterior coronary artery and multiple thrombi of the pulmonary vessels with pulmonary infarcts.

Barney and Mintz[5] state in their summary that a total infarct, with little or no urine from the affected side and a greatly decreased or absent function, with the presence of marked pain and tenderness, would suggest the correct diagnosis of renal infarct associated with decreased elimination of the iodide medium. They state in their Case 1, although several diagnoses were considered, infarction of the kidney was not one of them. In the case here reported, the preoperative diagnosis was that of left renal pathology (infarction was not mentioned) and it was not until the article by Barney and Mintz was published that the close parallel in the cases cited was observed. Renal infarction is probably more common and not diagnosed due to its vague clinical symptoms.

CONCLUSION

A case of renal infarction is reported. At operation, the true pathological alteration of renal infarction was observed on gross and microscopical sections. Autopsy at the death of the patient revealed multiple thrombi of heart and lungs with terminal infarct formation.

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MULTILOCULAR PAPILLARY CYSTADENOMA OF THE GALL BLADDER*

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BENIGN tumors of the gall bladder are of relatively rare occurrence. They are usually of small size and constitute incidental findings in the pathological examination of surgically removed gall bladders. Papillomas are the most frequently encountered, while cystadenomas are quite rare. Baumgartner,[1] in a series of 4575 surgically removed gall bladders, found 24 instances of cystadenoma. These tumors were quite small, averaging 1 cm. in diameter, and were situated in the wall in the region of the fundus. Other isolated cases of small intramural cystadenomas have been reported by Buzzi and Lascano Gonzalez[2] and Kordenat.[3] Robson[4] has recorded a similar though slightly larger tumor and Terrier and Ouvray[5] cite a case of Wiedemann's in which the tumor, measuring 4 by 1.5 cm., projected from the internal surface of the gall bladder into the cavity. With the possible exception of the last mentioned, these tumors were of no clinical importance but were pathological curiosities discovered in gall bladders which had been removed because of chronic inflammation or stones. In no case was there evidence of malignant degeneration. It would seem rather surprising if these rare tumors should not occasionally attain considerable size, comparable to the corresponding benign cystic tumors of the ovary, and thus give rise to clinical symptoms.

One such case has previously been reported by Bishop,[6] who operated on a woman of forty-two because of dull, sickly abdominal pain and a sensation of weight in the left lower abdomen and over the sacrum of eighteen months' duration. There was a history of previous bilious attacks with transient jaundice. Operation revealed the gall bladder to be replaced by a multilocular cystic tumor "the size of a child's head" and filled with mucoid fluid stained with bile. The cysts were lined with glandular epithelium. No calculi were present. Since radical removal was impossible, due to extension of the growth into the bile ducts, it was only partially removed. The remaining edges were sutured to the peritoneum and the lumen was cauterized. There remained a sinus which from time to time continued to leak bile.

Although the foregoing is the only recorded case of sizable cystadenoma arising in the gall bladder, similar tumors originating in various other parts of the biliary tract have occasionally been reported. Cystadenoma of the liver arising from the intrahepatic bile ducts[7] and, more rarely, cystadenoma of the extrahepatic bile ducts[8] are recorded in the literature. As in the case of such tumors of the gall bladder, malignant degeneration has never been observed. They are usually multilocular and contain a thick viscid fluid, commonly bile-stained but occasionally clear. Symptoms are referable to the mechanical bulk of the tumors or to biliary obstruction. Within the liver they are to be differentiated from hydatid cysts and from the congenital cystic disease of the liver occasionally seen in conjunction with the corresponding disease of the kidneys.

The following case is of interest in that it represents the second instance to be reported in which a cystadenoma arising in the gall bladder has attained a size sufficiently large to produce symptoms demanding surgical intervention. The tumor in this case was almost twice as large as that reported by Bishop thirty years ago.

* From the Free Hospital for Women, Brookline, Mass.

Miss C. R. (F. H. W. No. 22735), twenty-four years old, was admitted to the Free Hospital for Women on November 11, 1932,

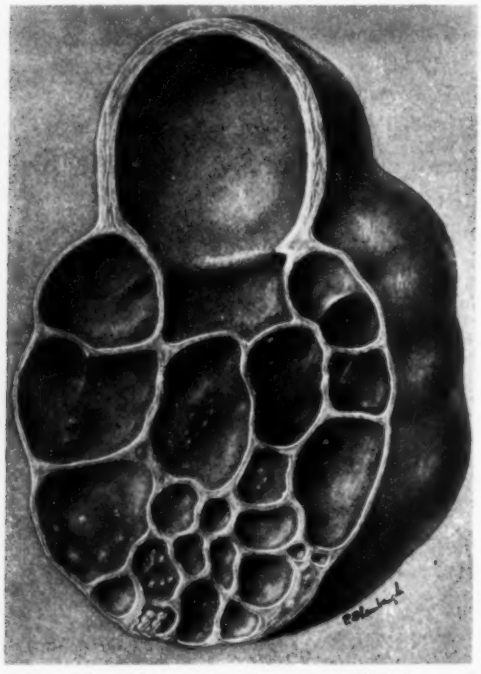

FIG. 1. Drawing of gross specimen, one-third actual size.

complaining of dull dragging discomfort in the right flank and below the right costal border of one year's duration. At first intermittent, the distress had become more or less constant for six months, aggravated by prolonged sitting or standing and relieved by lying down. During this period her appetite had been poor and she had gradually lost about 10 pounds in weight. She gave a story of two attacks of painless jaundice at fourteen and seventeen years of age; the first attack lasting for six weeks with marked anorexia, vomiting, clay-colored stools and dark urine, and the second attack lasting for two weeks with less severe symptoms.

Examination showed the patient thin and slightly pale but not jaundiced. An indefinite mass could be felt in the right upper abdomen and right flank. Her hemoglobin was 70 per cent; the Wassermann test was negative. Roentgenograms revealed a large soft-tissue mass in the right flank, and a pyelogram showed the ureter and kidney pelvis on the right displaced upward and medially. Urinary studies were negative. Preoperative diagnosis: probable renal tumor, right.

Operation was performed on November 15, 1932, by Dr. Frank A. Pemberton. The right kidney region was explored through a transverse incision in the right flank. Numerous

FIG. 2. Photomicrograph of small papilla. Stroma is of connective tissue and is slightly infiltrated with round cells. Epithelium is of characteristic columnar type normally seen in mucosa of gall bladder.

adhesions were encountered surrounding what at first appeared to be a large polycystic kidney. The incision was enlarged medially and the peritoneum, on being opened, revealed the tumor lying within the peritoneal cavity directly beneath the liver and attached by a wide base to its inferior surface. Further exposure was obtained by a right rectus incision crossing the first at right angles. The tumor was now seen as a bluish-gray cystic mass, 15 cm. in diameter, completely replacing the gall bladder and densely adherent to the surrounding structures on all sides. The appearance closely simulated an ovarian cystadenoma. Since it was impossible to remove the tumor intact, a large trocar was introduced, liberating a thick, dark green liquid, which was so gelatinous that it could be evacuated satisfactorily only by incising the wall and expressing the contents manually. The collapsed tumor was now, by painstaking dissection, removed except

for a small portion of the wall adherent to the under surface of the liver. The bile ducts could not be identified, due to the dense adhesions. Because of the precarious condition of the patient, it was necessary to control by gauze packing the considerable oozing from the tumor bed and to close the wound with drainage.

Pathological examination (No. 21034) demonstrated a polycystic structure with tough fibrous walls and a smooth inner lining which was in several places thrown up into papillary folds and projections. No calculi were present. The wall of the largest locule was 3 to 5 mm. in thickness, considerably thicker than the rest, and the lining was dark green and somewhat granular, whereas the lining elsewhere was gray and smooth. It seemed probable that this largest cavity represented the gall bladder proper. Microscopically, the wall of this cavity consisted of smooth muscle and dense fibrous tissue with chronic inflammation. The inner surface of this locule was covered with a thick layer of bile-stained hyalinized material, which completely replaced the mucosa. The walls of the other locules consisted of dense fibrous tissue with an inner lining of columnar epithelium. The tumor was apparently a multilocular papillary cystadenoma. This diagnosis was confirmed by Dr. F. B. Mallory.

The patient had a rather stormy convalescence, but made a good recovery with complete closure of the wound and cessation of drainage six weeks after operation. She was in good health three months later.

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RESTORATION OF THE VERMILION BORDER IN CERTAIN LIP OPERATIONS

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COLUMBUS, OHIO

THE restoration of the vermilion border of the lips in connection with plastic operations is of prime importance, but by no means always feasible. It seems worth while, therefore, to report a case in which by a new technique the desired end was accomplished:

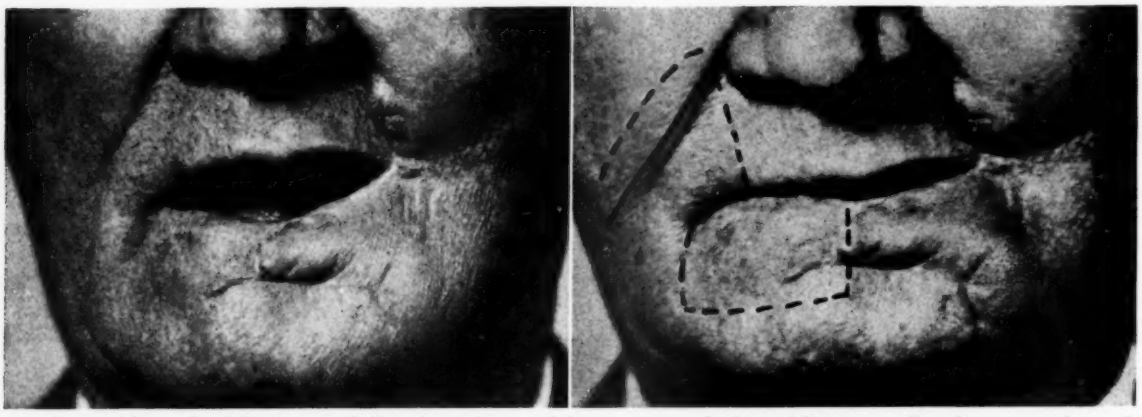

FIG. 1. Dotted lines, in right (normal) lip, show shape of tissue removed; dotted line extending from mouth to right side of nose indicates line of incision through upper lip; solid line, extending downward and outward, indicates incision extending *to* mucous membrane; dotted line parallel with this indicates line of incision through mucous membrane on inside of cheek, to provide for vermilion border of new lower lip. Other picture shows mouth when open as in ordinary conversation. Negatives untouched.

W. B., aged sixty-five, was seen at the Cancer Clinic April 4, 1933. He had been suffering from cancer of the lower lip for three years. Had had three treatments with radium but without benefit. He presented an ugly, cancerous mass involving the entire left half of the lower lip. An enlarged gland, the size of a hen's egg, was firmly attached at the margin of the lower jaw. There were many bad teeth and roots in both jaws. I advised the lip operation devised some forty years ago by Dr. Larger, the French surgeon, and removal of the enlarged gland; this to be followed by deep *x*-ray therapy.

Operation was performed April 6th. Complete removal of a little more than the left half of the lower lip was first made. This was followed by the usual Larger incision, involving the upper lip, as described by Davis in his "Plastic Surgery." As I was making the incision downward and outward from the nostril, my finger being on the inside of the lip, I suddenly realized that by cutting the mucous membrane lining of the cheek at a higher level than the main incision, I would have ample tissue to cover the new lip and thus secure the desired vermilion border. Acting on that idea I gained a full ¼ inch strip of mucous membrane. The little piece of normal vermilion border attached to the upper lip was snipped off as usual, the remaining teeth and roots extracted, and the tissue from the cheek adjusted in the space previously occupied by the excised half of the lower lip. The wounds were closed by the usual method, after I had carefully brought over the newly secured mucous membrane flap and thus procured the desired covering of the edge of the new lip. The enlarged gland was then removed in the usual way and apparently in its entirety.

The material used in closing the wounds was fine, annealed and enameled copper wire, such as is used in the manufacture of certain electric armatures, the wire being insulated by means of the enamel. This wire I have used for similar purposes for a good many years.[1]

[Concluded on p. 238.]

[1] *Cincinnati Lancet-Clinic*, Aug. 12, 1911.

CONGENITAL ATRESIA OF THE ESOPHAGUS WITH TRACHEOESOPHAGEAL FISTULA

ALBERT MATHIEU, M.D., F.A.C.S. AND HERBERT E. GOLDSMITH, M.D.

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CONGENITAL atresia of the esophagus is generally considered a rare developmental anomaly. This paper presents 2 such cases occurring in the same city, less than two months apart. We are indebted to Dr. S. G. Henricke for permission to use his case (Case II).

Since the first reported case by Durston,[1] in 1670, there have been 255 cases as reported by Rosenthal[2] in 1931. This report included 8 cases of his own. Historically, the case reported by Thomas Gibson[3] in 1696, is of interest for the thoroughness of recorded symptomatology, and the postmortem findings are such that no doubt is left in the reader's mind as to what developmental pathologic condition existed. This case report has been reproduced in detail by Plass[4] and makes very quaint and interesting reading.

In the English and American literature, excellent reviews on this subject have been made by Griffith and Lavenson[5] (1909), Cautley[6] (1917), Plass (1919), and Rosenthal (1931). Plass reviewed 204 references to congenital atresia of the esophagus, 137 of which he was able to verify himself. The others were either unconfirmed cases or repetitions. His work includes 18 pages of bibliography and covers the period from 1703 to 1916. The work of Rosenthal in 1931 has added 8 new cases. His paper is classic from the standpoint of pathology and etiology.

CLASSIFICATION OF ESOPHAGEAL ANOMALIES

Ballontyne[7] in 1904, from a very thorough study of the literature, made the following classification of malformations of the esophagus:

1. Absence of the esophagus in toto
2. Termination of the esophagus in a simple cul-de-sac
3. Termination of the esophagus in a simple cul-de-sac, the lower end of the canal communicating with the trachea or a bronchus
4. Tracheoesophageal fistula, without any other anomaly of the esophagus itself
5. Esophageal diverticula
6. Membranous obstruction of the esophagus
7. Double esophagus.

About 75 per cent of all esophageal malformations are of Type 3 in this classification and the cases presented here fall into this group.

ETIOLOGY

The etiology of congenital atresia of the esophagus is still somewhat obscure. The background is strictly theory. The early writers held to the theory that congenital atresia of the esophagus resulted from some intrauterine inflammatory or traumatic process. We now believe that a developmental error is the cause of this defect. This error takes place early, probably before the end of the first month of intrauterine life, since in the 4 mm. embryo, the esophageal and tracheal divisions are distinct. Kreuter[8] feels that persistence of the early embryonal stage, wherein the esophagus is a solid tube, causes the atresia. Schriddle,[9] however, finds that in the human embryo, the esophagus has a lumen at all stages of development. This distinctly shatters Kreuter's theory. Keith and Spicer[10] believe that the lateral tracheoesophageal ridges and folds, which normally proceed horizontally backward to meet the pulmonary buds and the esophagus, are diverted and proceed obliquely backward and dorsalward to produce the atresia.

Zeit[11] "feels that arrested development of the lateral ridges which unite incompletely in the midline, as the lateral tracheal and dorsal esophageal tubes are forming, would explain the fistula but not the atresia. For both to be caused by one factor, a faulty anlage with resulting malformation must have existed." Rosenthal feels that the development of the anomaly seems to rest on an early fundamental change in the endodermal cells that are to give rise to the esophagus, and not on any primary concomitant abnormalities. This change, he thinks, may be genetic and related to the anterior end of the neurenteric canal.

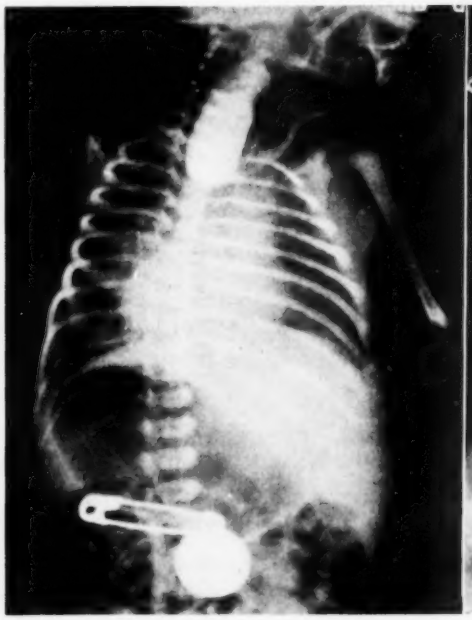

FIG. 1. Case 1. Anteroposterior roentgenogram taken antemortem. Stomach greatly distended with air. Barium in upper, dilated blind esophageal sac.

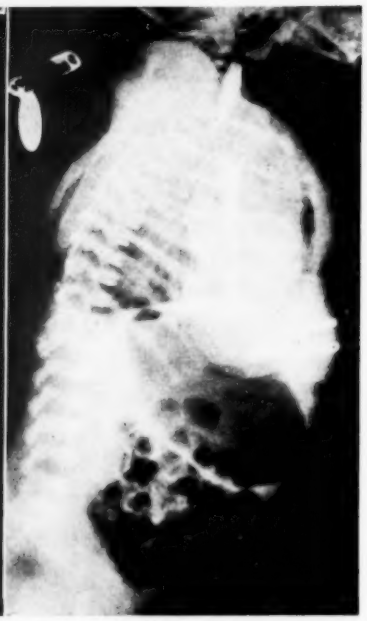

FIG. 2. Case 1. Lateral roentgenogram taken antemortem. Widely dilated stomach filled with air and barium in upper esophageal sac.

SYMPTOMATOLOGY

The symptomatology of congenital atresia of the esophagus is remarkably constant. The following 2 cases are classic in showing this constancy.

CASE 1. Baby N. was born approximately three weeks premature; its birth weight was 2620 gm. It was the first baby of a mother who had a normal pregnancy and the delivery of the baby was uneventful. The baby was seen by one of us (H. G.) when thirty-six hours old and until that time the baby had not retained any fluids. It had frequent attacks of cyanosis when taking liquids by mouth, each one of which had been preceded promptly by regurgitation. The baby took water eagerly by mouth but did not retain it. Water was given by tube and was promptly regurgitated through the nose. The baby had bowel movements of normal meconium without signs of blood. The baby had voided no urine since birth. An effort to pass a tube into the baby's stomach revealed the fact that there was a definite obstruction at about 10 cm. from the lips.

At the first examination the baby was, to all appearances, physically normal. The skin was moist, muscle tone was good, there was no evidence of dehydration. The fontanelles were neither bulging nor depressed. The eyes were clear and bright. A small amount of bloody, frothy mucus was noted at both external nares. The throat findings were negative. The chest presented no outward evidence of any pathologic condition. Many mucous rales were heard in the lungs. There was no alteration of breath sounds and no dullness or flatness. The stomach area appeared somewhat distended. The percussion note over the stomach was tympanitic and the abdomen was flat and soft. No masses nor areas of tenderness nor evidences of rigidity were present. The bladder was distended to about 2 cm. above the symphysis. A marked

phimosis of the prepuce was present. The testicles and scrotum were negative. The extremities presented no abnormalities except for

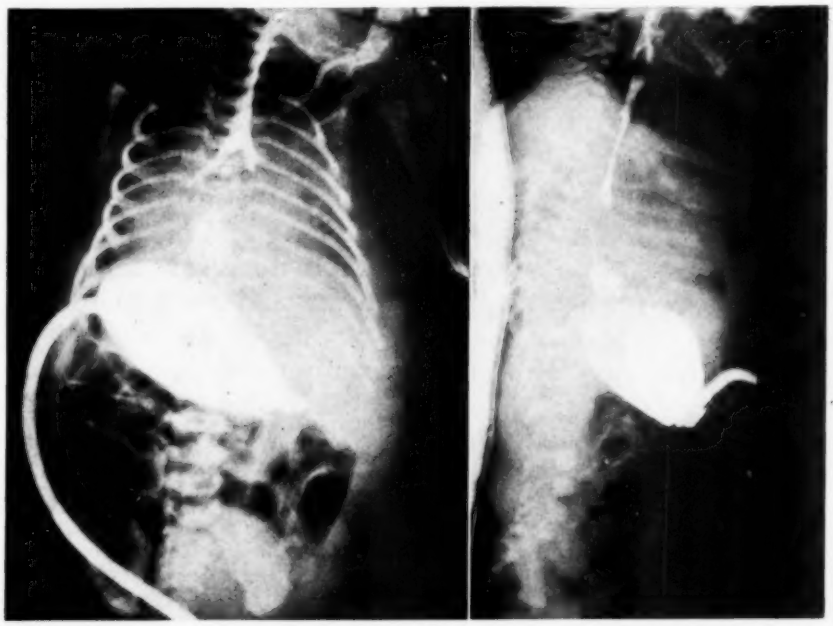

Fig. 3. Case 1. Anteroposterior roentgenogram taken post mortem. Stomach has been filled with barium through gastrostomy tube. Note that barium has traversed into lower end of esophagus and by way of small fistulous tract into point of trachea near bifurcation.

Fig. 4. Case 1. Lateral roentgenogram taken post mortem. Note that barium extends from stomach into lower esophagus and into trachea.

the scar on the left hand where a supernumerary thumb had been removed immediately after birth.

A catheter was passed into the esophagus and an obstruction was felt about 10 cm. from the lip margin. An attempt to pass water through the catheter produced a severe attack of coughing, regurgitation, and cyanosis after about ½ ounce had been introduced. Barium was injected into the esophagus and with the aid of the *x*-ray and fluoroscope, it was seen that the esophagus was filled for part of its length and ended abruptly in a blind sac. There was no sign of any barium in the stomach which was filled with a large air bubble. (Figs. 1 and 2.) During this procedure the infant developed marked asphyxia, but recovered when most of the barium was "milked" out of the mouth and nose.

A gastrostomy was done by Dr. Thomas Joyce at 9:45 P.M., January 23, approximately forty-five hours after birth. The stomach was found dilated and filled with air. No fluid or barium was found in the stomach. The infant returned from the surgery in good condition. Two hours later the infant was given 1 ounce of a 10 per cent glucose solution through the gastrostomy tube. There was an immediate expulsion of bloody, forthy material through the nose and mouth. The cyanotic attack was extreme, necessitating the use of prolonged artificial respiration and oxygen. The infant recovered from this attack only to expire thirteen hours later, after a marked elevation of temperature and repeated attacks of cyanosis, cough and dyspnea. The chest examination previous to death showed a marked, diffuse bronchopneumonia.

The accompanying illustrations (Figs. 3 and 4) were taken post mortem before autopsy.

Case II. Baby E., a female child, was born November 30, 1931, about six weeks premature. Its birth weight was 1132 gm. Examination of the infant at birth revealed no abnormalities. Because of prematurity the baby was placed in an incubator, but did not do well. It was soon noted that the infant could not swallow and that it was spitting up small bits of mucus. With the passage of a catheter an esophageal obstruction was noted about 5 cm. from the lips. A diagnosis of esophageal stricture was made at that time. Due to prematurity, no attempts at *x*-ray study were made. The infant died three days after birth.

There is a classic similarity in all cases of atresia of the esophagus with tracheal fistula. The symptomatology presents a

Fig. 5. Case 1. Post mortem specimen showing upper esophageal sac, hypertrophied and dilated. Probe passes through trachea and tracheoesophageal fistula at bifurcation of bronchi into lower end of esophagus which opens into stomach. Diffuse pulmonary hemorrhage.

pathognomonic picture easily understood from the underlying anatomical defects. The following is a short summary of the symptomatology:

1. Absolute inability to retain fluids
2. Regurgitation of fluid through the nose and mouth associated with attacks of dyspnea, cough and cyanosis when put to breast or when gavaged. The attacks are constant and occur with each attempt to give fluids by mouth
3. Frothy fluid at the nares and flow of saliva from the mouth
4. Failure to pass a catheter into the esophagus more than 10 to 12 cm. from the lip margin
5. Air in the stomach if a tracheal fistula is present
6. Moist rales throughout both lung fields
7. Gradually increasing temperature with development of bronchopneumonia
8. Increasing dehydration, loss of weight, and malnutrition
9. Inevitable death within two weeks usually from bronchopneumonia
10. Associated congenital anomalies.

PATHOLOGY

Autopsy report, Case 1, Dr. Thomas Robertson (Fig. 5): There was a blind pouch of the upper end of the esophagus 4.5 cm. in length which was hypertrophied and dilated. There was a tracheoesophageal fistula with the opening of the fistula at the point of bifurcation of the trachea. There were no congenital anomalies of the heart except the anatomically patent foramen ovale and ductus arteriosus which is expected at this time of life. The right heart was greatly dilated, associated with the pulmonary congestion, in turn associated with the aspiration of fluids from the stomach. There was a supernumerary thumb which had been amputated. The inability to void might have been due to a marked phimosis with a long prepuce. The meatus was patent with no anomalies. Each ureter was somewhat dilated and tortuous, and the kidney pelves were slightly dilated. The urinary bladder was distended.

Autopsy report, Case 11, Dr. Warren C. Hunter.

The esophagus ended in a blind pouch 3 cm. from the point of origin, terminating in a fibrous cord. In the non-cartilaginous portion of the trachea, beginning about 2 cm. above the carina, there is seen a crescent-shaped opening, which on probing is found to lead to a tube which on dissection upward from the stomach proves to be the esophagus. There was nothing grossly visible in the lungs suggestive of a pneumonic process, but microscopic sections revealed an early bronchopneumonia. There were no associated abnormalities.

GROSS PATHOLOGY

There is a marked similarity in the gross findings of all cases of congenital atresia of the esophagus with tracheal fistula. The upper end of the esophagus ends in a blind pouch and is usually 3 to 4.5 cm. long. The proximal portion of the esophagus is dilated and hypertrophied to a diameter of 1 cm. or more. The normal esophagus in infants measures about 4 to 6 mm. This hypertrophy may be explained on the basis of futile attempts of the infant to swallow amniotic fluid or as evidence of abnormal growth.

The lower portion of the esophagus is normal in its entrance into the stomach. The upper segment, however, narrows its lumen to about 2–4 mm. and enters the trachea at or very near the bifurcation. The point of entrance into the trachea may take place 0.5–2.0 cm. above the bifurcation. A few cases have been reported where the fistula existed between the esophagus and a bronchus. There may, however, be an overlapping of the upper and lower portions.

The two segments of the esophagus are usually separated by 1 cm. of fibrous tissue. Associated anomalies, of which the most common is atresia ani, are frequently found. Congenital defects involving the kidneys, extremities and lips have also been noted. The supernumerary thumb and phimosis noted in Case 1 were the only associated defects noted in the 2 cases here reported.

Because of the desire to preserve the gross structures of such an anomaly, a study of microscopical pathology has not been made in most cases. Generally speaking, from those who have reported the histology on these cases, the extreme ends of the esophagus appear normal in structure. Rosenthal finds that the transition from tracheal structures in the proximal end of the fistula to esophageal structures in the distal end of the esophagus is gradual.

With the gradual development of dehydration and inanition and the overflowing of regurgitated material into the lungs, the lungs become an ideal location for the development of bronchopneumonia. If the infant has weathered every attack of regurgitation with its accompanying dyspnea and cyanosis, it must inevitably fall victim to pneumonia.

PROGNOSIS AND TREATMENT

Up to the present time every case of congenital atresia of the esophagus associated with tracheal fistula has been fatal. No method has yet been introduced which can successfully carry on the nutritional demands of the infant. Rectal feeding and intravenous glucose as an adjunct prove inadequate in promoting growth and nutrition. Surgery must be held forth as the only optimistic procedure for lessening what is now an inevitable death.

Gastrostomy has been done in many cases with the idea of prolonging life to a point where later surgery may be effective. This has been proved inadequate, however, since flooding of the lungs has occurred in those cases associated with fistula. Jejunostomy is unsatisfactory since it is practically impossible to feed an infant by this method. Ritcher[12] in 1913 advised gastrostomy with closure of the upper end of the lower portion of the esophagus. He reports 2 cases. One baby died of operative shock, the other lived twenty-four hours. At autopsy no fluid was found in the lungs of his second patient. Brenneman[13] feels that intrathoracic surgery holds the greatest hope for relief of congenital atresia of the esophagus, still mindful, however, of the insurmountable barrier to be overcome and the pediatric limitations of such a case so treated.

Brenneman's philosophy towards such cases is broad and deep. It is worthy of repetition in toto:

> When one considers on the other hand that nearly all of these infants have other anomalies, that practically all of them either have bronchopneumonia or will almost inevitably

get it if the upper portion of the esophagus is not drained into the lower portion, that a "restitution ad integrum" of the esophagus does not yet seem feasible, that without this, life, even if possible, would be intolerable, that the child could probably not be made to live even if successfully operated on, for pediatric reasons; that no such infant has ever lived, no matter how treated, and finally, that parental sentiment must be weighed heavily in the balance, then if one, after careful counsel with the parents, decides to let the patient die as peacefully and painlessly as possible, one need lose no sleep because of that decision.

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CONCLUSION OF DR. BALDWIN'S ARTICLE*

In closing wounds where avoidance of scars is especially desirable; it is soft, is very easily twisted or tied, and leaves a practically invisible scar at the point of transfixion.

These stitches were removed at the end of two full weeks, healing having taken place without a particle of infection. The case was presented to the Columbus Academy of Medicine May 1, a little less than four weeks after operation, as an illustration of Shakespeare's well-known dictum that "There's a divinity which shapes our ends, Rough hew them how we will." For the first time, probably, in the history of the Academy the "exhibit" was roundly applauded. A little later photographs were taken showing the mouth closed, and also with the lower jaw slightly dropped. In full yawning there is some deformity of the left angle, but under ordinary circumstances there is no noticeable defect of any kind.

Correspondence with Dr. John Staige Davis, Professor of Plastic Surgery at Johns Hopkins University and author of a well-known textbook on plastic surgery, indicates that this is the first instance in which a vermilion border has been secured on such a transplant.

*Continued from p. 232.

OSTEOPOECILIA*

ARTHUR R. BLOOM, M.D.

DETROIT

OSTEOPOECILIA is a relatively rare condition of generalized small areas of condensation occurring throughout the bony skeleton with the exception of the skull and vertebrae. These bodies vary from 2 to 3 mm. to 3 to 5 cm. in size and are located mostly in the spongeosa of the epiphyses, various long bones and the metacarpals and metatarsals. The spots are rather closely clustered giving the bones a speckled appearance, hence the term osteopoecilia. The foci are round or oval. The long axis invariably corresponds to the long axis of the bone. They do not come to the surface nor raise the bone or periosteum. There are no symptoms or characteristic history peculiar to the condition and practically all the recorded cases have been discovered accidentally.

This condition has a number of synonyms, namely, osteopoecilia or osteopoikiliosis, osteitis condensans generalisata, osteopathia condensans disseminata, and osteosclerosis fragilis generalisata. The number of terms applied to this condition is confusing. The last in particular represents an entirely different condition. Köhler[14] in his book presents a good description of osteopoecilia but continues on to mention such complications as spontaneous fractures, enlargement of the liver, spleen and lymph glands, anemia and a fatal outcome; showing that he includes this condition in marbling diseases of the bone. He ends the paragraph by saying, "The best name for the disease is to call it Albers-Schönberg disease, after its discoverer." Although Albers-Schönberg is considered to have described the first case, his name is applied to a different disease entity. König[20] also noted this confusion existing among some writers for he stated:

Some authors identify the disease with so called "marble" bone disease. This is not correct because in the latter disease, there occur chiefly massive, structureless areas of density combined with thickening of the cortical layer and narrowing of the bone marrow. These changes are also found in diaphyses and there is nearly always a thickening of the sella-turcica and posterior clinoid processes. The fragility of the bone is increased.

Wachtel in 1921 remarked on the numerous terms used. He objected to the term osteopoecilia because bizarre bone pictures are seen in radiographs of numerous bone affections so that one might speak equally of osteopoikiliosis of the bones in tuberculosis, atrophy, etc. On the other hand, the designation like osteitis takes for granted the still unknown nature of the disease in a rather improbable direction. Until further elucidation of the etiology, he proposes the term of "disseminated condensing osteopathy." I am inclined to agree with him.

INCIDENCE

Although most authors credit Albers-Schönberg with describing the first case of osteopoecilia, Stiede[1] in 1905 reported cases of circumscribed condensing of the bone in the region of the substantia spongiosa based on roentgen examination of macerated bone and anatomical specimens. He stated he found such changes in 18 to 20 per cent of 11 roentgenograms of calcaneus bones, 2 instances in the plates of 6 scapulae, and 2 instances in 6 plates of the heads of the humerus. He also studied these changes microscopically and found that the bone nuclei were composed of compact islands of corpuscles and lamella in irregular arrangement while

* From the Roentgen Department of the North End Clinic, Detroit.

the surrounding bone shows the Haversian canals and lamella to be well defined.

Since then the following men have reported cases: Albers-Schönberg[2] one in 1915, Ledoux-Lebard et al.[3] one in 1913, Laurent-Moteau[4] one in 1916 (?), Moreau[5] one in 1916, Wachtel[6] one in 1923, Richarz[7] one in 1922, Schele[8] one in 1922, Voorhoeve[9] three in 1924, Steenhuis[10] one in 1926, Buschke and Ollendorf[11] one in 1928, Van Dorp and Beucker[12] one in 1928, Gluck[15] one in 1929, Newcomet one in 1929, Amundsen[17] one in 1930, Guelliars and Mollaret[18] one in 1930, Awalischwili[19] one in 1930, König[20] one in 1930, Schmorl one in 1931, Reiser[22] one in 1930, Haack[23] one in 1931, Van Pee[26] one in 1931, Wilcox[24] two in 1931, Windholz[25] three in 1932.

FIG. 1. Right hand. Note numerous foci in carpals, metacarpals, phalanges and lower ends of radius and ulna.

There is a total of 28 cases reported besides those of Stiede and our case. There probably are more cases which were not reported or are unseen as there is no history or complaint associated with this condition. However, the fact that so few have been reported in comparison with the tremendous amount of bones radiographed throughout the world indicates that it is a very rare condition.

ETIOLOGY

Few authors agree as to the cause of this condition while many frankly admit that the etiology is unknown. Köhler credits Lexer with the statement that the distribution is typical of tuberculosis hematogenesis ossium; a condition arising from bacterial embolism of the end-arteries of the spongiosa and adds that "Nature appears to offer us in this anomaly a view of the narrower passages of the circulation within the bones." Few authors agree with him although Windholz writes that a bacterial embolism can not be excluded.

Practically every case appeared in a different condition. Ours was in a congenital luetic. Guelliars and Mollaret's occurred in an achondroplastic dwarf. Wilcox suggests a parathyroid disfunction and Windholz noted slight deviation of the calcium and phosphorus metabolism in the blood on 2 cases. On the other hand, Voorhoeve believes that this condition belongs to the group of dyschondroplasia, stating that disseminated condensing osteopathy and dyschondroplasia are two manifestations or two phases of the same process. Schmorl, who examined a case microscopically, could find no evidence of inflammation, infection or any other cause other than a congenital "anlage." Albers-Schönberg's case occurred in a soldier complaining of joint pain, Van Dorp and Beucker's patient had abdominal tuberculosis and Haack discovered his while raying a patient for evidence of bone injury following an accident.

Buschke and Ollendorf noted a peculiar skin lesion of slightly elevated oval papules which is termed dermatofibrosis lenticularis disseminata in their case of osteopoecilia. Windholz reported 3 more cases in which this skin condition was found. Furthermore he examined microscopic sections of these

portions of skin and found that there was a connective tissue hyperplasia involving all the layers of the cutis and the superficial layers of the subcutis in the area of visible pathological changes. The focus was not sharply defined and the epithelium was not involved. The bundle of connective tissue protruded into the subcutaneous fat but the papillae were well preserved. He suggested that there is a definite relationship between these two conditions and that probably many more cases of osteopoecilia had this type of skin changes which was overlooked, as inspection alone is not sufficient to identify the presence of tumefaction. However, Pokorny and Pokorny[13] reported a case of dermatofibrosis in which after carefully raying the entire skeleton they were unable to find any evidence of osteopoikiliosis.

A number of authors report a hereditary influence. Voorhoeve found this condition occurring in a sister, a brother and father. Wilcox's cases were in a father and daughter. We examined our patient's family with the exception of the father and a sister who were not available. The other members of the family with the exception of a sister showed no changes. This one sister had an isolated spot at the base of the second metacarpal which resembled the multiple foci found in the boy.

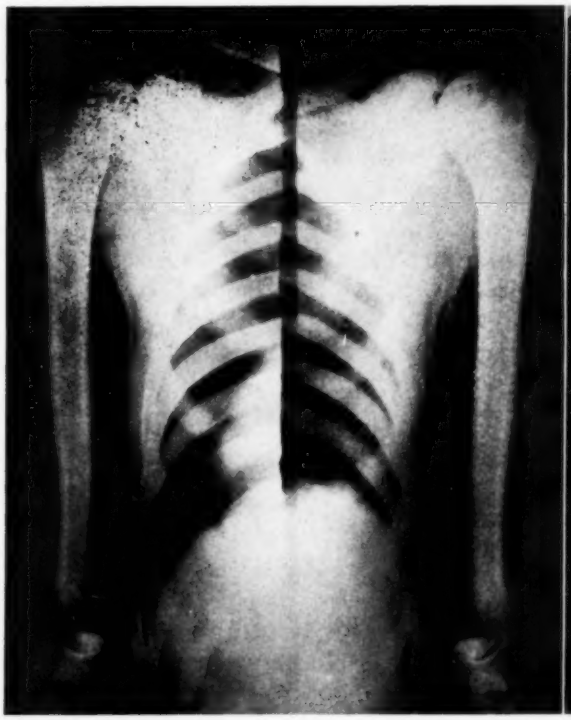

Fig. 2. Shoulder girdle, ribs and arms. Note foci in humeri, scapulae, upper radii and ulnae and single focus in right clavicle.

Fig. 3. Pelvis. Note spots on pelvis and upper ends of femora.

Windholz is inclined to accept the hypothesis according to which osteopoikiliosis is a hereditary and congenital condition. He feels that the frequent simultaneous occurrence of osteopoikiliosis and lenticular disseminated dermatofibrosis shows that the responsible gene-mutation affects not only the osteoplastic system but also the remaining mesenchyma. Frequent abnormalities of shapes of the individuals speak in favor of this assumption. Analogous observations can be made in a series of other hereditary systemic diseases of the skeleton as blue sclera with osteopsathyrosis.

This condition may be found at any age and occurs in both sexes; but it predominates in the male two to one.

Climate and geography have no bearing as the review of the international literature would show.

FIG. 4. Elbow joint. Note foci of lower end of humerus and upper end of radius and ulna.

PATHOLOGY

The only cases that came to autopsy were the ones reported by Stiede and Schmorl. Schmorl's patient had an old osteomyelitis with metastasis and died of marasmus and amyloidism. He incidentally had osteopoecilia. The anatomical studies in regard to the bony foci are as follows:

The bone foci which cause the shadow in the roentgen picture and which on inspection with the naked eye apparently consist of compact bone, are not composed of bone tissue corresponding to the compacta of the shaft bones but consist of spongy bone. These bony trabeculae are generally thicker than the spongiosa trabeculae and plates, otherwise present in this location, but the individual trabeculae of which the foci are composed lie very close together. As shown by serial sections, the foci are fitted into the normal spongiosa and are connected with it in such a way that the spongiosa trabeculae or plates are adjusted to their surface without a sharp boundary being demonstrable; several normal bony trabeculae may be adjointed on the surface of the foci. Besides bony trabeculae with lamellar structure, there are others, especially thinner ones, which are composed of finely fibrillar bone tissue. The bone corpuscles contained therein are often rather clumsy and large, as found in newly developed connective tissue bone. No reliable verdict can be given as to the genesis of these trabeculae, on the basis of the microscopic examination. The trabeculae are probably derived from the fibrillar component of the bone marrow.

REPORT OF CASE

G. Y., male, aged seventeen, came to the Clinic because of recurrent attacks of sore lids since he was three years of age. He is blind in the right eye. He presented many cardinal symptoms of congenital lues such as a saddle nose, Hutchinson's teeth, enlarged epiphyses of the wrist, a saber shin, pronounced costoclavicular joints and wing scapulae. In addition he had blepharitis, pthisis bulbi, and complete atresia of the right side of the nose. He did not make satisfactory progress in school. The Kahn test was negative.

The mother gave a history of numerous miscarriages and one stillbirth. The father is confined to an institution. The living siblings are a sister who is five years older, a sister who is three years younger, a brother four years younger and another sister seven years younger. The Kahn test was negative in all, but the spinal fluid curve in the younger brother slightly resembled a tabetic curve. The diagnosis in the case was blepharitis, congenital lues, and juvenile taboparesis.

We rayed the long bones to see if we could demonstrate luetic changes. Instead we found the following picture: There were numerous areas of increased density varying in size from 1 to 15 mm. in the carpals, metacarpals, phalanges, heads and the upper half of the shaft of the humeri, lower ends of the humeri, upper and lower ends of the radii and ulnae, scapulae, upper and lower ends of the tibiae

and fibulae and there was one single spot 5 mm. in diameter in the middle of the right clavicle and one 3 mm. in diameter in the left jaw. The spine, ribs and skull were free.

We examined the mother and the two younger sisters and a younger brother. The older sister and father were not available. No changes were found except in the case of the next youngest sister, in whom a single spot 2 mm. in diameter was found at the base of the second metacarpal of the left hand.

CONCLUSION

Another case of osteopoecilia is recorded, bringing the number up to 29. A plea is made for uniformity of terminology as the numerous synonyms tends towards confusion.

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OSTEOMYELITIS OF THE SPINE*

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THE purposes of this paper are to review the literature upon osteomyelitis of the spine, to present a general discussion of the clinical picture, and to report 3 cases which showed differing manifestations of pyogenic infection of the spine.

Osteomyelitis of the spine was first reported by Lannelongue[1] in 1879. By 1906 Donati[2] was able to collect a large number of cases from the literature and to write a fairly comprehensive review. In 1915 J. Volkmann[3] reviewed all the literature of this disease and he was able to collect 83 cases from the literature to which he added 4 cases of his own. In an admirable summary he discussed the pathology, symptomatology and treatment. Little information has been added since that time except that the use of the *x*-ray has been an aid toward making earlier diagnosis.

The disease may be divided into the acute and chronic forms. These forms vary markedly as to course and prognosis. Any organism may be responsible, but in the majority of cases bacteriologically investigated Staphylococcus aureus has been recovered. Staphylococcus pyogenes-albus and Micrococcus tetragenus have also been found. Occasionally bacteria may be seen in smear but may not be cultured. Furunculosis, small abscesses, nail bed infections, pediculosis, acne pustules, infected eczematous areas, and insignificant minor infections have preceded the onset of the disease in a large number of cases. Occasionally abscessed teeth are found in association with the disease and may be assigned an etiological rôle. The relationship of trauma is hard to evaluate. In a certain number of cases no history of antecedent trauma is obtainable, in others it is very likely only an incidental occurrence. A striking fact is that of those cases in which a history of trauma can be definitely elicited and appears to bear some relationship to the disease, a high percentage is in the cervical region, a small percentage in the lumbar region. Moreover, there is a much higher percentage of cases in males, which would seem consistent since males are prone to suffer more trauma than females. Of the cases reported by Volkmann 72 per cent were in males; 70 per cent in the cervical spine, 52 per cent in the thoracic, and 80 per cent in the lumbar. In the males trauma appeared to be a definite etiological factor.

In keeping with the fact that bone infections in general most often affect growing bones in the first and second decades, almost 50 per cent of the cases fall between the ages of eight and seventeen years.

From the pathological standpoint, Volkmann divided the cases into those of primary periosteal infection and primary medullary infection. He described the periosteal type as follows:

> In the beginning the hyperemic, inflamed, edematous, thickened periosteum is filled with round cells often with scattered areas of hemorrhage, later infiltrated with pus in tiny spots or in larger areas. This pus elevates the periosteum from the bone and destroys in this manner the vessels that go from the periosteum into the bone.

[1] Lannelongue, O. De l'ostéomyélite aigue pendant la croissance. Paris, 1879.

[2] Donati, M. Ueber die akute und subakute Osteomyelitis purulenta der Wirbelsaule. *Arch. f. klin. Chir.*, 89: 1116–1163, 1906.

[3] Volkmann, J. Ueber die primäre akute und subakute Osteomyelitis purulenta der Wirbel. *Deutsche Ztschr. f. Chir.*, 132: 445–510, 1915.

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When the infection begins primarily in the marrow cavity, the marrow becomes hyperemic through hemorrhages. The first intensive red will later become dark, almost black and the marrow which is infiltrated with cells and serum is under considerable pressure and will well up over the cut surface. In the majority of cases there occurs a purulent infiltration and subsequent fusion of the marrow elements.

In many cases the infection involves the intervertebral disc or the articular joint capsule, and in such cases the condition might be more properly spoken of as an osteo-arthritis. In cases where abscess formation takes place, there may occur sequestration and a small amount of reactive ossification while the pus is able to burrow its way out through varying paths. The first possibility is that it will break into the spinal canal and then follow through the numerous veins which connect the ligament and the bone on one side and the bone and the dura on the other. It, of course, may remain epidural but in a certain percentage of cases it enters the spinal canal with immediately disastrous results. In many cases no direct point of communication may be found and in such cases it may be rightly or wrongly assumed that the infection is blood-borne. In the majority of these severe cases the dura and arachnoid of the spinal cord and brain are the seat of numerous small abscesses. In those cases in which the pus remains outside the dura there may be symptoms from compression of the cord and a large proportion of authors report neurological manifestations in their cases. These range from anesthesias or hyperesthesias over the body to total or partial paralysis of the arms and legs with sometimes disturbances of rectal and vesical sphincter control.

The second possibility is that the pus in its attempt to get to the surface will break through to the paravertebral tissues. In those cases in which the process is not walled off there is great danger of the process being disseminated and causing a general infection. When the process is located principally in the arch, the transverse or spinous processes, it can by burrowing directly backward come to the surface; otherwise it cuts its way through unyielding muscle and fibrous tissue which it may cause to become necrosed, down to and through the muscle planes as a psoas abscess and eventually reach the surface. The latter occurrence, it may be noted, is a very rare one.

CLINICAL PICTURE

About 70 per cent of the cases pursue an acute course; the remainder have a subacute or chronic course. In the subacute and chronic forms the involvement is chiefly in the arches and processes rather than in the body. In general, osteomyelitis of these regions presents a sudden acute onset with severe general reaction which dominates the clinical picture. The patient frequently comes to the physician with a temperature of 40°C. or more, with albumin in the urine, and occasionally with jaundice, weak pulse and severe headache. Such general symptoms may be accompanied by vague and varying complaints of pain in different sites so that an accurate diagnosis is difficult and in many cases cannot be made. Many patients therefore die without the aid which surgery might offer. However, the course is not always so relentless. Many patients first complain of gradually increasing pain in the back or pelvis with pains radiating into the legs. In a certain number of cases the spine is very sensitive to twisting and compression movements of the body. This is especially so when the body of the vertebra is affected. In these less severe cases the surrounding tissue tends to become involved with swelling and edema, venous engorgement, hypertrophy of the regional lymph nodes and frequently phlegmons and large abscesses.

If the pus extends into the subdural space or into the spinal canal, much more severe symptoms arise. These vary according to the location in the spine. If the cervical region is involved, the neck is

held stiff with the head immobile or held in the hands to prevent the jarring and trauma incident to motion. Here the collection of a small amount of pus can result in severe symptoms from compression or irritation of the nerves leading from the cord or of the cord itself with subsequent neuralgias, weakness, monoplegias, paresis or paralysis. If the dura is invaded, the picture of a severe meningitis supervenes with frequent involvement of the brain. Not infrequently the pus breaks through forward and appears as a retropharyngeal abscess, or it may burrow laterally in the neck. A not uncommon occurrence is a descending mediastinitis.

In the dorsal spine there is considerable tendency to break through anteriorly with formation of retropleural and mediastinal collections of pus. In addition, the pleural cavities may be involved with a resulting pleurisy, empyema or pneumonitis.

The anatomy of the lumbar spine permits of a great variety of clinical pictures. Involvement of the spines and transverse processes can readily give edema and swelling over the loins, while abscesses which break through forward can involve numerous important structures. The proximity of the great lumbosacral plexus makes pressure phenomena here a common occurrence with varying manifestations. As in Pott's disease, formation of psoas abscess is a rather frequent occurrence. The pus may extend along the muscle beneath the sheath, around it or may infiltrate the muscle substance. In some instances large retroperitoneal collections of pus may occur with frequent involvement of the perirenal space and the kidneys as well as with the occurrence of pelvic abscess. However, the peritoneal space is rarely involved. Gibbus may occur in all three sites when the bodies are destroyed.

DIAGNOSIS

The diagnosis of pyogenic infections of the spine is very difficult and it is rare that a case is not considered to be some other condition before the correct diagnosis is established. The reason for the difficulty of accurate diagnosis is obvious: the condition is extremely rare, the signs are usually those presented by other diseases, the spine is not easily accessible for other examination, and the appearance in the roentgenogram is rarely characteristic early in the disease. Pyogenic infection has been confused with typhoid fever, tuberculous spondylitis, cerebrospinal meningitis, pneumonia, rheumatism, influenza, general sepsis, torticollis, myelitis, Landry's paralysis, and abscesses of the subphrenic, perirenal and lumbar types. Probably the greatest single aid in diagnosis that we have is the roentgen ray. With pain in the spine on pressure or on motion, fever, polymorphonuclear leukocytosis, gibbus with destructive processes in one or more vertebrae shown by the roentgen ray, this condition must be considered. During the progress of an established septicemia a progressive infection of the spine may occur and should be kept in mind.

PROGNOSIS

The condition is an extremely grave one and carries with it a high mortality. The following table gives the mortality rates of several different authors. It is interesting to note the gradual lowering of the mortality rate since 1896 as published by the various authors.

Year	*Author*	*Percentage of Deaths*	
1896	Makins and Abbott	71.4	
1900	Hahn	58.0	
1905	Joachinisthal	56.6	
1906	Donati	45.5	
1911	Grisel	51.0	
1913	Tscherniak	41.5	
1915	Volkmann	41.8	
1930	Steindler	8.0	(small series)
1931	Oehlecker	37.1	

These figures represent the gravity of the condition in general. The acuteness of the disease increases the death rate. In a large series of cases there is found a difference in mortality rates according to which division of the spine is involved. In general, the involvement of the cervical

spine carries with it a mortality rate of approximately 50 per cent, involvement of the thoracic spine a mortality rate of 30 per cent, and involvement of the lumbar spine a mortality rate of 45 per cent. In cases where the diagnosis was established and the proper operative procedures carried out, the mortality rate was cut to approximately one-third of the general rate.

TREATMENT

All authors recommend that as soon as the diagnosis is established, incision and drainage be instituted. Drainage of the complicating abscesses is also indicated. Treatment of the various types of spinal deformities involves the same general type of treatment that has been found useful in treating tuberculosis of the spine, since physiological rest of the diseased part is most essential. It is hardly necessary to emphasize the tremendous importance of general supportive measures, such as the maintenance of the water balance and high caloric food intake, to combat sepsis. Where there is considerable pain, opium derivatives should be used freely.

CASES

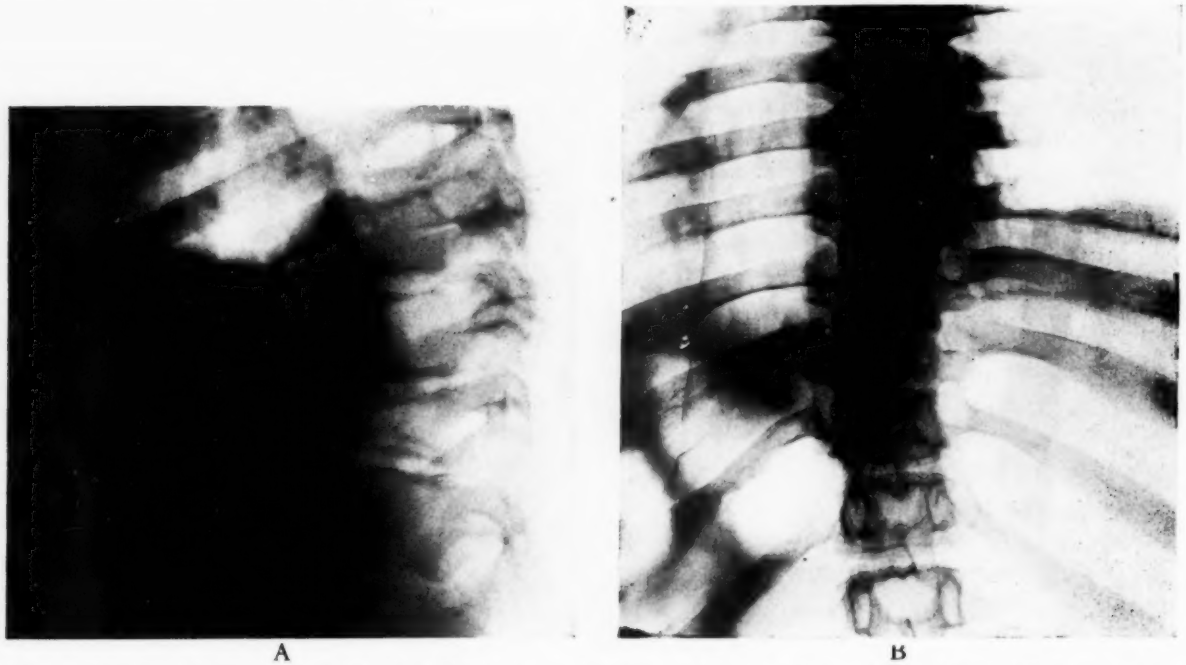
Case 1. A fourteen-year-old school boy was admitted to Lakeside Hospital on November 25, 1931 with the complaint of pain in the left hip and lower dorsal region, accompanied by high fever. At the age of three he had developed acute osteomyelitis of the left tibia. Subsequently he developed foci in the left femur and humerus. He had been admitted to Lakeside Hospital and other hospitals on numerous occasions for treatment of various infections. At seven years of age he had had a dislocated left hip following pyogenic arthritis. At eight years of age he had had acute nephritis which cleared up. At twelve years he had been admitted to Babies and Children's Hospital because of loss of weight, cough, fever and sputum. Roentgenograms of the chest taken at that time showed extensive infiltration of the right lung especially, and this together with the report on one examination of sputum positive for tubercle bacilli and a positive tuberculin reaction prompted the staff to make the diagnosis of pulmonary tuberculosis. The patient remained in the hospital for about eight months and was then discharged much improved. In December, 1929 he had a wedge osteotomy performed to correct a flexed right knee. In February, 1931 he developed an abscess over the left posterior flank and this was incised. In October, 1931 he complained of pain at the inferior angle of the right scapula for ten days. Fluctuation appeared and an abscess beneath the muscle planes was incised and drained. This gradually cleared up but pain of a flitting character persisted throughout both sides of the chest. There was, however, no tenderness and the motion of the spine was normal. On November 2, 1931 he had marked pain around the left hip joint with protective spasm. The white blood count was 7800 but his temperature was 39°C., and the urine, which on previous occasions had been normal, showed a large trace of albumin, many red and white cells and a positive benzidine reaction. The pains persisted and he had exacerbations of temperature up to 39°C. with intervals of three days of freedom from fever.

On admission to the hospital the physical examination revealed a well-developed and nourished but obviously sick boy. There was dullness in the right side of the chest posteriorly with a few râles, and slight general abdominal tenderness; the spleen was palpable and the blood pressure was 154/94. The sinus on the back had healed, but there were numerous scars from previous infections. Laboratory data on admission were: W.B.C. 7600; R.B.C. 3,850,000; differential: polymorphonuclears 77 per cent, lymphocytes 13 per cent, large mononuclears and transitionals 7 per cent, and undifferentiated 3 per cent; hemoglobin 48 per cent (Sahli); tuberculin 1/7000 negative; two hour phenolsulphonphthalein excretion test 55 per cent; blood urea nitrogen 17.9 mg. per 100 c.c.; and negative Widal reaction. The urine showed a slight trace of albumin, a strongly positive benzidine reaction, 10 to 20 white cells, many red cells, and occasional hyaline and granular casts.

His course on the wards was marked by extreme pyrexia which maintained an average of 39.5°C. (103.1°F.) but varied considerably above and below this figure in a septic fashion. A blood culture showed B. coli communior and the same organism was isolated in the urine, but it was felt that this did not warrant the diagnosis of B. coli septicemia. Roentgen-ray

examination of the chest showed an area of increased density overlying the right base, and it was felt by the roentgenologist that this globoid shadow to the left of the spine which was believed to be an abscess.

The exact diagnosis remained in doubt. It



A B

FIG. 1. Case 1. A. Lateral view of spine which shows definite evidence of destruction with wedging. B. Antero-posterior view shows narrowing of tenth vertebral body and osteomyelitis of ninth rib.

probably represented pneumonia but that tuberculosis could not be ruled out. Neo-iopax injection showed the kidneys to be very large but equal in size, and it was stated that this picture suggested acute nephritis. After eight days on the Orthopedic Service he was transferred to the Medical Service in view of the pulmonary manifestations, septicemia and nephritis.

While on the Medical Service he had the same hectic course, and four days after he had been transferred there, a large abscess on his back spontaneously ruptured with evacuation of 4 oz. of pus from which a pure culture of Staphylococcus aureus was isolated. It was believed that this abscess communicated with the pleural cavity. The signs at the right base increased and a definite diagnosis of pneumonia was made by the Medical Service.

Seventeen days after his admission to the hospital a definite gibbus of the lower dorsal spine was found by one of us (M. H.). The patient was returned to the Orthopedic Service but his poor general condition precluded any operative procedures. A roentgenogram (Fig. 1) taken at this time suggested a destructive process of the tenth dorsal vertebra with a was obvious that the patient had nephritis. The pulmonary condition seemed most likely to be pneumonia but tuberculosis could not be excluded. It, therefore, seemed certain that he had abscess and collapse of the tenth dorsal vertebra and involvement of the ninth rib. He continued to have a septic temperature with white counts varying between 9,000 and 18,000, and a normal differential count. His general condition was extremely poor; the anemia increased. The cardiac response was poor and pulmonary disease steadily progressed. Despite stimulative measures he gradually became weaker and died twenty-five days after admission to the hospital.

At autopsy[4] the tenth dorsal vertebra was found to be the seat of an osteomyelitis (Fig. 2) surrounding which there was a fluctuant mass that projected into each pleural cavity. On opening this cavity a large amount of thick yellow exudate escaped. This was stained for acid-fast organisms and none found. The left pleural space was found to be practically filled with seropurulent exudate and the postero-lateral aspect of the lung was fixed by dense fibrous adhesions. The pathological diagnoses

[4] The autopsy was performed by Dr. H. M. Dixon.

were: suppurative osteomyelitis of the tenth dorsal vertebra with perivertebral abscess, focal suppurative nephritis and myocarditis,

Fig. 2. Case I. Body of vertebra with marrow filled with granulation tissue which is undergoing necrosis.

purulent pleuritis (left), bronchopneumonia, hyperplasia of spleen, focal necrosis of liver and pleural adhesions.

Case II. A male of nineteen years was admitted to the Medical Service of Lakeside Hospital on December 4, 1928. Five days before admission he had noted pain in the neck, upper back and left shoulder. At the onset of the illness the pain was principally in the left side of his neck and was aggravated by movements of the upper body and by coughing. Four years previously he had had a stiff and sore neck following a strain while playing, but this cleared up shortly with no sequelae. Several weeks prior to the onset of the present illness he had had a coughing spell and spat up blood-streaked sputum.

The temperature on admission was 38.2°C. The head and neck were held in a fixed position with the chin turned to the right. There was marked pain on motion of his head and neck, especially to the right, tenderness in the left supraclavicular fossa, over the left trapezius and to the left of the spine in the region of the second to fourth dorsal spines. He complained

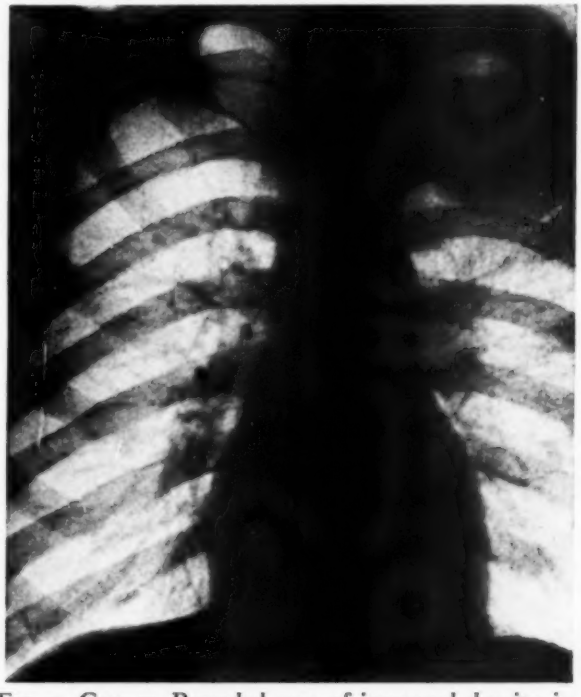


Fig. 3. Case II. Rounded area of increased density in left upper lobe suggesting abscess of lung probably communicating with mediastinum.

of weakness of the left arm which showed some atrophy and some pain along the inner aspect. The white count was 12,000, the urine was normal, spinal fluid normal, Wassermann reaction negative and blood culture negative. Roentgenograms of the upper dorsal and cervical vertebrae showed no definite evidence of pathologic change and those of the chest showed hilar shadows prominent on both sides with some evidence of congestion in both fields. There were also numerous areas of calcification and the heart was prominent in the region of the auricles. He was given salicylates without relief of the pain. Four days after admission the temperature rose to 39.5°C. There was tenderness over the margin of the left trapezius and beneath and anterior to the sternomastoid. While the reflexes were active elsewhere, they were diminished in the left arm. A diagnosis of meningitis with plexus neuritis was considered. On the sixth day after his admission, while his temperature was ranging between 38° and 39°C., the white blood count was 20,000 and on the following day it was noted that he continued to hold his neck in a fixed, rigid position, that

there was a definite fullness in the left side of the neck which transmitted the carotid pulsation and that there was increased resistance in neck or mediastinum, later involving the lower mediastinum. Stereoscopic roentgenograms of the chest showed a soft shadow of increased

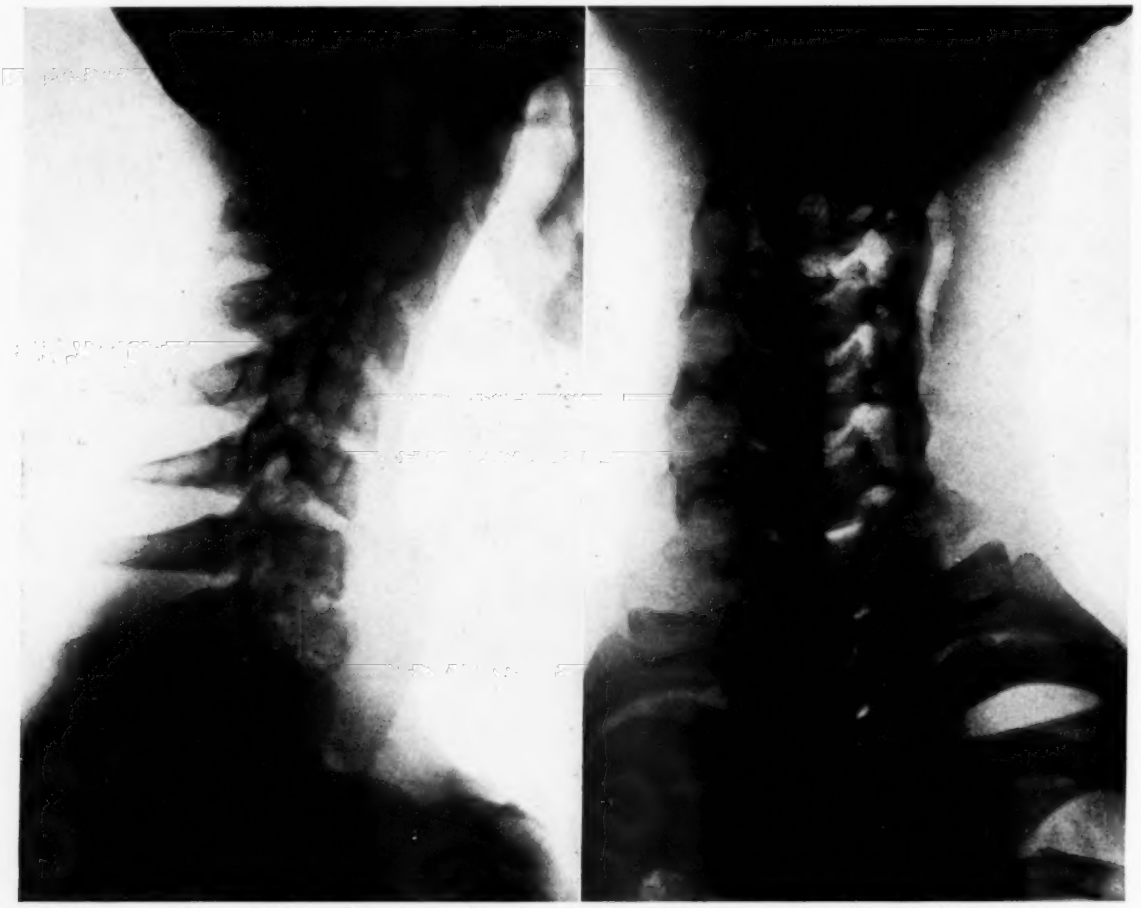


FIG. 4. Case II. A. Lateral view of cervical spine shows destructive process involving sixth cervical vertebra. B. Anteroposterior view of cervical spine shows rarefaction in neighborhood of articular facets with displacement of trachea to right.

the entire left side of the neck. The patient was cyanotic. The chest showed some limitation of expansion of both sides of the upper chest. The right side moved upward and outward normally but the medial end of the left clavicle seemed fixed and appeared to move dorsad pulling the first and second ribs with it, giving the chest a see-saw movement with inspiration. Pulsation was seen to the right of the sternum in the first and second interspaces and diffuse precordial activity was visible. There was increase in the mediastinal dullness to the right and to the left. A pleural-pericardial friction rub was heard to the left of the sternum in the fifth and sixth interspaces. There was some dullness at the right base.

The onset and course of this illness suggested an abscess having its origin possibly in the density in the left upper chest with heavy bronchial markings extending to the hilus (Fig. 3). The appearance suggested pneumonia to the roentgenologist although he felt that the rounded circumscribed character of the shadow was unusual in pneumonia.

Shortly after that the temperature, which had reached 40°C., subsided, and it did not go higher than 38°C. during the remainder of the stay of 156 days in the hospital.

Roentgenograms taken on the fifteenth hospital day showed a fluid level in the area of increased density and the diagnosis of abscess of the lung was quite well established. With the subsidence of the fever the process in the lung gradually cleared and on discharge there was nothing clinically or roentgenologic-

ally to indicate that there had been an abscess of the lung.

The disability of the neck continued, however, and on the thirty-sixth hospital day roentgenograms showed loss of the intervertebral discs above and below the sixth cervical vertebra with irregularity of the body and rarefaction of the neural arch (Fig. 4). At this time the white count was 12,000 and the differential was essentially normal. He was seen by one of us (M. H.) who felt that the condition would be benefited by immobilization in a plaster shell. Accordingly, he was transferred to the Orthopedic Service where he was placed in an anterior and posterior shell. This immobilization was carried out in the belief that the condition represented a cervical Pott's disease and that after the subsidence of the acute process it would be possible to carry out a fusion of the cervical vertebrae.

With rest his condition improved remarkably. Roentgenograms, taken before the contemplated fusion operation, showed that the destructive process had completely subsided and evidence of healing was present (Fig. 5). The only persistent pathological finding was a slight narrowing of the intervertebral disc between the sixth and seventh cervical vertebrae. Instead of the fusion operation, therefore, the patient was given a Calot jacket and discharged to a home in the country.

Two years later, on August 2, 1930, motion in the neck appeared normal and he had no complaints referable to the spine. The roentgenograms showed complete healing with regeneration of the partially destroyed sixth cervical vertebra.

Case III. A thirty-year-old octoroon was admitted to the Medical Service of Lakeside Hospital, on December 27, 1931. She complained of low backache of five weeks' duration. She had been ailing somewhat during the previous five or six months with anorexia, loss of weight and possibly some fever.

Her past history was irrelevant except that during her first pregnancy, ten years prior to her admission to the hospital, she had been confined to bed during the last three months with chills, fever and night-sweats which her physician attributed to diseased kidneys and for which she was placed on a milk and cracker diet. The delivery was uneventful but for the three months following she had chills and fever and some pain in the left hip. She was later treated for "dislocation of the left hip" and after five or six months she was able to discard her crutches. Two subsequent pregnancies were uneventful. Her husband stated that she had complained of intermittent pain in this hip since the first pregnancy. The family history was unimportant except that three children had died of tuberculosis.

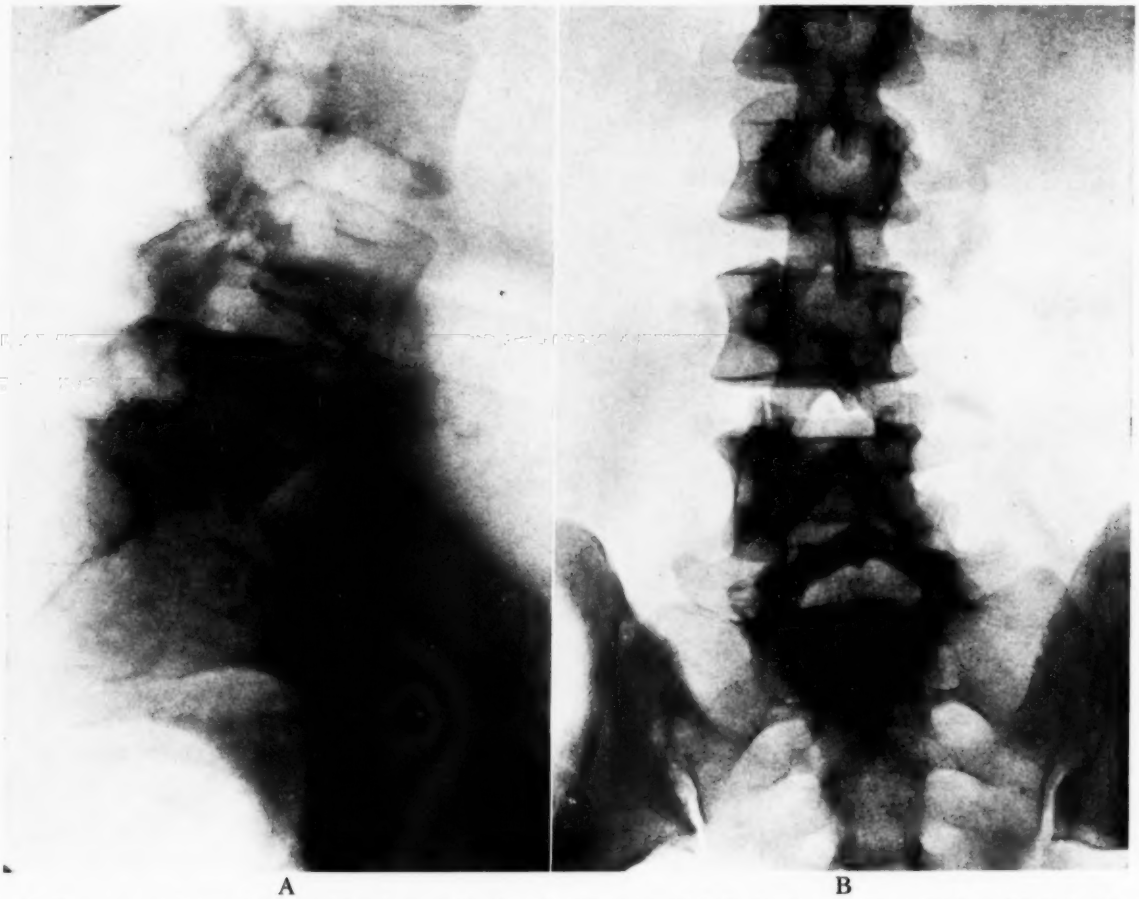
Fig. 5. Case II. Lateral view of cervical spine showing restoration of density and regularity of outline of body of sixth cervical vertebra.

At the time of admission she was obviously sick and showed the effects of long-continued fever in the dryness and flabbiness of skin and extreme general emaciation. Her gums showed a typical Vincent's infection at the margins and there were many carious teeth. The left kidney was readily palpable but non-tender. There was a tender area over the sacrum. Wasting of the muscles of the back and of the left gluteus was present. Upon attempts at passive motion the lumbar portion of the back was rigid. The hips showed normal bony landmarks with normal motion. At the time of admission it was felt that the condition was probably either tuberculosis or a pyogenic infection involving the sacroiliac joints or the sacrum.

For three weeks the patient was on the Medical Service. She ran a septic course with temperature variations of 3° to 4°C. (reaching

40.8°C.), with rapid pulse and chills and she continued to have the lower lumbar pain. The initial white count was 9000 and during the two months that she was in the hospital others ranged to 15,000. The majority were around 12,000 with a predominence of polymorphonuclear neutrophiles. There was a secondary anemia with a red count of 3,100,000 and hemoglobin of 62 per cent (Sahli). The red count later declined to 2,200,000 and her hemoglobin to 35 per cent (Sahli). During her stay in the hospital she had four blood cultures that were positive for streptococci. The urine on admission showed a faint trace of albumin, 12 to 15 white cells, occasional red cells and 0 to 2 granular casts per high power field. Smears of the gums showed a bacterial flora consistent with Vincent's infection; cervical smears were negative and the stools were negative.

Roentgenograms suggested no evidence of active tuberculosis in the lung fields but films of the spine and pelvis disclosed a spondylolisthesis of the fifth lumbar vertebra and a questionable destructive process in the first sacral segment (Fig. 6).



A B

FIG. 6. Case III. A. Lateral view of lumbosacral spine showing spondylolisthesis with irregularity of inferior intervertebral margins. B. Anteroposterior view of lumbosacral region showing tilting of fifth lumbar neural arch.

Her care on the Medical Service was palliative and consisted of a high caloric diet, blood transfusions totalling 1400 c.c. of citrated blood and an attempt to sterilize her blood stream by the intravenous use of phenyl-mercuric-chloride. Immediately following the injection of the latter chemical the blood cultures were sterile for a short period. Despite the transfusions her anemia progressed, and despite the phenyl-mercuric-chloride later blood cultures were positive. On the last few days on the Medical Service she had numerous red cells and casts in the urine for the first time.

A consultation with the orthopedic surgeon was held and it was decided that immobilization of her spine in a double plaster spica would be beneficial. Accordingly she was transferred to the Orthopedic Service and there placed in a double plaster spica. Subsequent to her immobilization in this spica her temperature

showed a marked decline and she felt much better subjectively. A blood culture taken during this remission, which lasted a week, and Staphylococcus aureus was obtained. Two days after this her temperature reached 41.4°C. and she continued to show an extremely septic

FIG. 7. Case III. Later view shows increased destruction of inferior part of fifth lumbar vertebra.

FIG. 8. Case III. Photograph of specimen showing destructive process between fifth lumbar and first sacral segments.

was positive, however, and the urine continued to have much albumin, red cells and casts. Her temperature began to mount again and when the splint was bivalved in a few days, a large pressure spot was found over the sacrum. From then on she began to have a moderate elevation of temperature at least once daily and an *x*-ray taken February 9 (forty-six days after admission) showed an increase in the destructive process involving the inferior margin of the fifth lumbar vertebra (Fig. 7). Because her general condition was so poor, surgical interference was decided against for the time, and anterior and posterior shells were made into which she could be fitted with greater comfort. About a week after the discovery of the pressure spot a large fluctuant area was found at the site of the pressure spot. This was evacuated and pus resembling that from a cold abscess was obtained. Guinea pig inoculation was negative but a mixed culture of streptococcus type of temperature and despite transfusions continued on a downward course. On February 18 iritis appeared in the left eye and the next day for the first time there were signs of cardiac decompensation. She rapidly developed heart failure and died on February 20 (fifty-sixth hospital day).

At autopsy[5] there was evidence of general septicemia with enlarged spleen, lymph nodes and liver, and there were microscopic abscesses of the lungs.

At the level of the first sacral segment, extending out along both psoas muscles and inferiorly to the level of the rectum, was a large abscess filled with white, creamy, fluid material. It had remained entirely retroperitoneal. Upon removal of the anterior abscess wall, pus was seen to exude from between the centrum of the fifth lumbar vertebra and the sacrum. The sacroiliac joints were loose and purulent material was present in these articulations. The centra of the fifth lumbar and first sacral verte-

[5] The autopsy was performed by Dr. W. W. Waddell.

brae were pale (Fig. 8), and the intervertebral disc and joint capsule were missing.

Sections through the body of the fifth lumbar vertebra disclosed a chronic osteomyelitis with destruction of the intervertebral disc and its underlying osseous lamella. The marrow was fibrous with relatively few exudative cells (Fig. 9). The pathological diagnosis of this local condition was chronic inflammation of the lumbosacral and sacroiliac articulations with destruction of the cartilage and capsule, eburnation of adjacent bone and fibrosis of the bone marrow. The other pathological diagnoses were: acute pyelonephritis, hydronephrosis (right), hydropericardium (150 c.c.), bronchopneumonia, pulmonary edema, chronic fibrous pleuritis (right), acute splenic hyperplasia, chronic endocervicitis, calcification and caseation of tracheobronchial lymph nodes, decubitus ulceration over the sacrum, dental caries and gingivitis. Cultures of the blood and of the abscess cavity were positive for streptococcus bits.

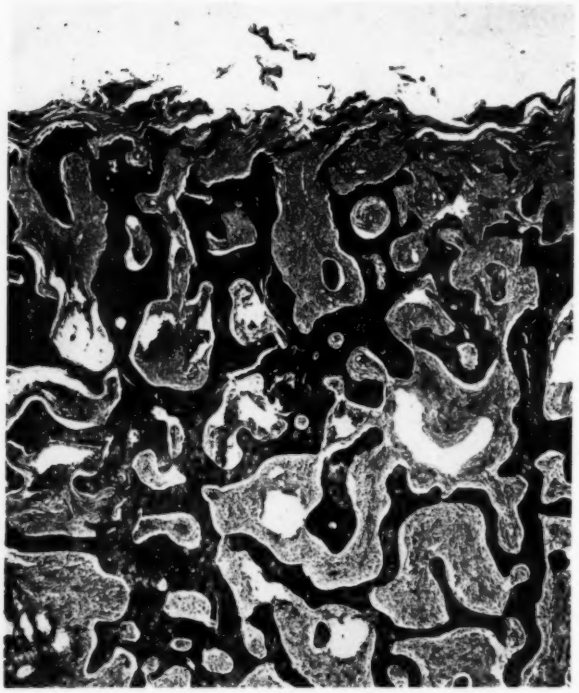


FIG. 9. Case III. Histological section through vertebral body showing increased trabeculation and infiltration with polymorphonuclear leucocytes.

The source of this infection was not determined. It is possible that this process might have existed from the time of the original illness but this seems very improbable. Whether the abscess followed septicemia or whether it served as a reservoir for general infection is difficult to say. The former is probably the case.

CONCLUSIONS

It is readily appreciable that pyogenic infections in and around the spine usually result in a fulminating disease with an average mortality rate of 50 per cent, that frequently the diagnosis with our present methods is not made until the infection is well established. Trauma appears to play a prominent role as a contributing factor in the male. It is striking, although to be expected, that 50 per cent of the patients with osteomyelitis of the spine fall in the age period between eight and seventeen years.

The several pathological types of the disease are the (1) periosteal, (2) central, (3) arthritic and (4) osteoarthritic.

The treatment is supportive; incision and drainage should be carried out at the earliest moment the diagnosis is made. Three cases of differing types are reported. The first developed gradually in a boy who had had many previous foci of osteomyelitis in the long bones. Drainage, unfortunately, was not done and at autopsy the eighth dorsal vertebra was found to be the seat of an extensive osteomyelitis with a mediastinal abscess.

The second patient was a male of nineteen years in whom the roentgenograms showed a destructive process in the sixth cervical vertebra in association with an abscess of the lung. There was no surgical interference. With physiological rest the process cleared up; there was surprising restoration of the vertebral body within about six months.

The third patient was a female of thirty years with a persistent streptococcal septicemia in whom a pyemic process appeared in the intervertebral disc between the fifth lumbar and first sacral segments causing spondylolisthesis and invasion of bodies of the fifth lumbar, first sacral and sacroiliacs together with a psoas abscess. Surgical interference was deemed inadvisable. The postmorten findings are reported in detail.

The authors acknowledge their indebtedness to Dr. A. R. Moritz for the photomicrographs.

MANAGEMENT OF GONORRHEAL ARTHRITIS

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ARTHRITIS, as a complication of gonorrhea, has been a serious problem both from the standpoint of the relief of pain in the acute stage and the resulting disability in the involved joints. There are several agents of proved value in gonorrheal arthritis which are not generally known, namely: hyperpyrexia by fever diathermy, joint insufflation with air and intravenous injection of ammonium iodoxy benzoate (amiodoxyl).

Observers have emphasized various methods of treatment, such as stock and autogenous vaccines, intramuscular injection of autogenous synovial fluid, foreign protein therapy, convalescent serum, injection of the prostate and seminal vesicles with Pregle's iodine and other chemicals, oral medication, intravenous therapy with mercurochrome, deep *x*-ray therapy and operative treatment, which have been used with occasional striking success, but in most cases the results have been disappointing.

DIAGNOSIS

The diagnosis is mainly derived from the history of a recent acute urethritis or, when possible, smears or cultures of joint fluid. In the presence of an acute joint involvement, this former means is useful at least as a basis for a therapeutic test.

PATHOLOGY

The pathology generally described consists of three fairly definite types or stages of infection, namely:

1. An exudative periarthritis with a metastatic abscess or focus in the periarticular tissue.

2. Synovitis with the infection and inflammation of the synovial membrane giving rise to a serous or serofibrinous exudate within the joint proper, which eventually may go on to the formation of fibrous adhesions.

3. Pyoarthrosis, causing a destruction of the articular cartilage by autolytic action and pannus formation. This frequently progresses to bony ankylosis.

TREATMENT

The treatment should include:

1. Immobilization of the affected joints. This reduces the pain, puts the part to rest and prevents development of deformities. Plaster is most effectual for this because it is more comfortable.

2. Active treatment of the urethritis, if present. (This was carried out by the urologists in our Clinic).

3. General measures, such as salicylates and bed rest.

4. Injections of amiodoxyl benzoate, not oftener than twice a week. Four to ten injections are usually needed.

5. Local measures, such as aspiration or irrigation of the joint and insufflation of the joint with air.

6. Hyperpyrexia by fever diathermy in refractory cases.

7. Physical therapy: diathermy and massage have proved most satisfactory.

We are presenting 22 cases of gonorrheal arthritis, 11 of which were treated with the aid of the previously mentioned adjuncts and the remaining 11 of which were treated prior to the use of these methods in this Clinic. The average age of these cases was thirty years; 80 per cent were males; 60 per cent of the group were married. The average duration of the arthritis was six weeks; the average time elapsed from the onset of acute urethritis to the onset of arthritis was seventeen days. The ankle was involved most frequently with the wrist and knee next. These were followed

by the hip, tarsus, elbow, shoulder and temporomandibular joint.

For several years certain cases of chronic proliferative arthritis in this Clinic have been treated with ammonium iodoxy benzoate (amiodoxyl) with indifferent results. Campbell, in an informal clinic, stated that they were obtaining striking results with amiodoxyl in gonorrheal arthritis. In his opinion, 90 per cent of cases were improved or cured by the use of this drug. Recently it has been used in this Clinic in cases of gonorrheal arthritis. This medication was given twice a week for a series of four to ten injections and used as an adjunct to the usual orthopedic measures.

The only previous report of the use of this drug in gonorrheal arthritis was by Keys, who used it in 2 cases in 1929, and he reserved his opinion of it there due to the fact that they were mild cases and he had not used it in a large enough group. While our clinical material has not been large, I feel the striking results warrant a report, especially when compared with a similar group in which this drug was not used.

Amiodoxyl was given intravenously, one ampule being dissolved in 100 c.c. of normal saline solution. Injection was done slowly, at least seven minutes being allowed for the solution to enter the vein. The reaction of the patient varies with the individual and with the injection. Usually the early injections of a series are attended by a more severe reaction. The patient complains of pain and stinging in the involved joints, burning sensations in the nose, mouth and eyes, and occasionally of nausea. Vomiting is rare.

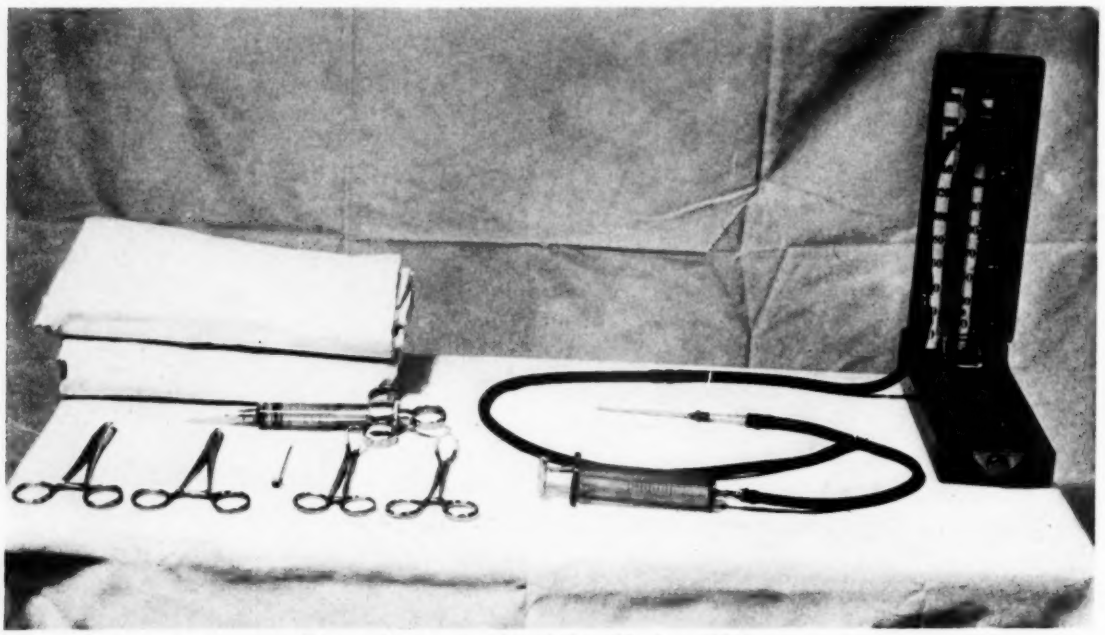

Fig. 1. Apparatus for air insufflation of joints.

Porter and Rucker in 1929 presented a series of cases with acute gonorrheal synovitis involving the knee. They recommended air insufflation of the joint in the early stages. Their cases did uniformly well. Since then we have used this method in a number of similar cases. Our apparatus for this is shown in Figure 1. The fluid is first aspirated from the joint under local anesthesia, a large caliber needle being used. The syringe is then disconnected, leaving the needle in place and a "T" tube is attached to the needle. The leg of the "T" tube is then attached to a spinal manometer and the remaining end is

TABLE 1
GONORRHEAL ARTHRITIS; NO AMIODOXYL

Case	Joints	Diagnosis	Pathology	Treatment	Result
E. R. I	Both ankles. Left knee. Left shoulder. Left wrist.	History.	Periarthritis.	Foci treated.	Subsided activity.
R. H. II	Right elbow.	History.	Synovitis.	Not recorded.	Did not return for treatment.
M. R. III	Left temporomandibular. Left hip. Right knee. Fingers, right.	History.	Periarthritis; synovitis.	Baking and massage, 2 months.	Recurrence in right knee.
M. A. IV	Right shoulder.	Acute urethritis eight days previously.	Periarthritis.	Splinted, 20 days.	Slight improvement.
J. B. V	Right knee. Left hip. Left ankle.	Frequent infection.	Synovitis.	Physical therapy.	No improvement.
R. H. VI	Right knee.	Not recorded.	Synovitis.	Physiotherapy. Plaster immobilization. Sedation.	Subsided symptoms.
B. K. VII	Left knee.	History acute urethritis, two months previously.	Synovitis.	Aspiration. Sedation, 25 days.	Subjective improvement.
R. P. VIII	Left ankle.	History.	Periarthritis.	Short period of splinting. Antiluetic treatment.	No improvement.
F. P. IX	Right ankle. Right thumb. Left shoulder.	History.	Periarthritis.	Rest and immobilization (was psychiatric).	Still active on discharge from hospital.
M. C. X	Knee.	Course.	Old pyoarthrosis.	Plaster immobilization. Physical therapy.	Ankylosis.
O. N. XI	Knee.	History.	Old pyoarthrosis.	Deformity corrected: severed iliotibial band; skeletal traction; plaster; manipulation.	Ankylosis.

TABLE II
GONORRHEAL ARTHRITIS TREATED WITH AMIODOXYL

Case	Joints	Diagnosis	Pathology	Treatment	Result
J. R. I	Left knee.	Acute urethritis two months previously.	Synovitis	Amiodoxyl, 6 injections. Plaster immobilization.	Pain relieved. Free motion. Much improved.
J. W. II	Left ankle. Left wrist. Left elbow. Right toes.	Acute urethritis three weeks previously.	Synovitis; Periarthritis.	Amiodoxyl, 4 injections.	Normal joints. Prompt relief from pain.
A. K. III	Right hip.	Urethritis three weeks previously.	Synovitis.	Amiodoxyl, 4 injections. Plaster hip spica.	Pain relieved soon. Motion much improved.
J. A. IV	Right ankle. Left wrist.	Urethritis one week previously.	Periarthritis.	Amiodoxyl, 6 injections. Plaster immobilization. Physical therapy.	Immediate relief of pain. Excellent motion.
M. S. V	Right shoulder.	Smear positive.	Pyoarthrosis.	Amiodoxyl, 6 injections. Airplane splint. Aspiration.	No pain. Limited motion in all directions.
F. C. VI	Right wrist.	Acute urethritis present.	Periarthritis; Synovitis.	Amiodoxyl, 6 injections. Plaster immobilization. Wrist incised.	Immediate relief of pain. Fair motion.
P. H. VII	Left midtarsal joint.	Acute urethritis present.	Periarthritis.	Amiodoxyl, 6 injections. Plaster one week. Physical therapy. Whitman foot plate.	Relief of pain after first two injections. Good weight-bearing foot.
J. L. VIII	Both feet. Both ankles. Left shoulder.	Chronic discharge. Acute infection 10 yrs. previously. Culture positive.	Synovitis; Periarthritis; Pyoarthrosis of shoulder.	Amiodoxyl, 6 injections. Drainage shoulder. Plaster immobilization. Diathermy.	Complete relief. Fair motion in shoulder.
B. S. IX	Both wrists. Left ankle. Left elbow.	History of acute urethritis two years previously.	Periarthritis.	Amiodoxyl, 2 injections. Plaster immobilization. Physical therapy.	Pain relieved. Patient left before course ended.
D. J. X	Both knees. Left ankle. Left foot. Left wrist. Left shoulder.	1. Positive culture. 2. History.	Synovitis.	Amiodoxyl, 8 injections. Insufflation knees, 4 times. Splints. Diathermy.	Relief of pain with amiodoxyl. Increase of motion with air. Joints normal.
R. S. XI	Lt. shoulder (6 mo.). Lt. hip (2 mo.). Rt. great toe (one month).	Discharge present.	Synovitis; Periarthritis.	Typhoid vaccine. Physical therapy. Amiodoxyl, 13 injections.	Relief of pain. Improvement in motion.

attached to the syringe. Air is then forced into the joint, the tube being pinched with a hemostat to prevent the escape of air while the syringe is removed and the piston extracted again preparatory to injection of more air. This process is repeated until the manometer reading rises to 40 mm. Hg. The needle is then quickly withdrawn and a cotton and colodion dressing is applied. No further dressing is needed. The patient is encouraged to use the joint. Absorption of the air takes place in four to five days.

The insufflation of the joint distends the soft tissues, thus preventing contact between the inflamed synovial membrane and the joint surfaces. This permits motion in the joint without aggravation of the process by trauma. It also prevents formation of fibrous adhesions and relieves pain. Because of this motion permitted, disuse atrophy is not seen. After the inflammatory process has subsided, return of function is more rapid and more complete. Figure 2 shows the distention present in an insufflated knee.

The cases of pyoarthrosis were aspirated or irrigated, by means of the two needle method. Surgical drainage is occasionally necessary when the process progresses in spite of more conservative measures. At this time the joint may be irrigated with a weak mercurochrome solution.

Our experience with hyperpyrexia by fever diathermy in gonorrheal arthritis is limited (Case II of the detailed case reports). This patient received two treatments, a week apart. His temperature rose to 103°F. or higher and was sustained for a period of several hours. His improvement was most marked after this therapy.

CASE REPORTS

Six cases which have been treated by these methods have been selected for more careful report and consideration.

Case I. J. A., male, twenty-nine years of age, was admitted to the orthopedic service November 21, 1929, with an acute urethritis, epididymitis and arthritic involvement of the left wrist and right ankle. The affected joints showed increased local heat and swelling.

Fig. 2. Distention in insufflated knee.

Fever rose to 101.8°F.

X-ray films showed destruction of the articulating surfaces of these joints. They were immobilized in plaster for one week, after which the casts were bivalved and diathermy and massage begun. At the same time amiodoxyl was started and continued at biweekly intervals until ten injections were given.

The urethritis was treated by the urologists and under this therapy the symptoms and fever subsided gradually until he was discharged on January 28, 1930, with free and painless motion in the involved joints.

Case II. J. L., male, forty-eight years old, was received as a transfer from the medical service, with a diagnosis of acute infectious polyarthritis, on February 18, 1932. There

was a fluctuant area over the left shoulder and an acute synovitis of both ankles. Temperature was 101°F. Malaise was marked. There was no recent history of gonorrhea.

The following day the shoulder was aspirated; pus was obtained, the smears and culture of which showed gonococci. This aspiration had to be repeated once.

The ankles were immobilized in plaster from February 20 to March 3, 1932, after which the casts were bivalved. Diathermy was started and the casts were gradually removed.

In addition to this, he received hyperpyrexia by diathermy on two occasions. Through all this treatment he received amiodoxyl once weekly for six injections. Pain and fever subsided after the first two injections.

Whitman foot plates were made for him when he was able to stand and he walked out with painless ankles and fair motion in his shoulder on April 6, 1932.

Case III. J. W., male, twenty-one years of age, was admitted to the hospital on November 19, 1931, with an acute urethritis and periarthritis of the left ankle and both feet. The urethritis was treated by the urologists. He was kept in bed for three days and given one amiodoxyl treatment while in the hospital, after which improvement was so rapid that he was discharged on November 23, with no other treatment except Whitman foot plates. Three other injections of amiodoxyl were given in the Out-Patient Department. There was no residual pain or disability.

Case IV. D. J., male, twenty-seven years of age, was admitted to the hospital December 8, 1930, giving a history of acute urethritis three months previously. His knees were red, swollen and painful, in addition to which he had periarthritis involving his left ankle, right foot and left hand.

The knees were aspirated on December 11, 1930, and immobilized in Cabot splints. Air insufflation was done to the left knee, to a pressure of 30 mm. Hg on December 17 and December 23. The same procedure was carried out on the right knee on December 12, January 19 and January 30.

Over this period amiodoxyl was injected twice weekly for four weeks. Diathermy was administered to all affected areas.

The patient was discharged February 12, 1931, with Thomas heels. All joint symptoms had subsided and had normal, painless, free motion. Symptoms in the knees subsided rapidly after the first insufflation. After further treatment, the periarthritis gradually subsided.

Case V. F. C., male, twenty-eight years of age, colored, was admitted to the hospital on October 3, 1932. A urethritis was present. The right wrist had been incised and from the incision purulent material was draining. Culture of this revealed gonococci. The wrist was in flexion and motion was very painful. Under gas anesthesia, the wrist was manipulated to a position of rest in dorsiflexion and maintained there by plaster.

Four injections of amiodoxyl were given over a two week interval. The pain disappeared, the joint stopped draining and the incision healed. Some limitation of motion was present but the wrist was in a good functional position and was painless.

Case VI. M. S., female, aged twenty-six years, entered the hospital January 23, 1932, complaining of pain in the right shoulder, which had begun the previous evening. Her temperature was 101.6°F. White blood count was 19,200 with 90 per cent polymorphonuclear leucocytes. *X*-ray films were negative. History was negative. Her fever continued and shoulder finally became fluctuant so that three days later it was incised and drained. Fifteen cubic centimeters of pus were obtained. The joint was irrigated with 2 per cent mercurochrome and saline solution. Gonococci were cultured from the pus and from the vaginal smear.

An abduction arm splint was applied and six injections of amiodoxyl were given over a period of three weeks. The temperature dropped to normal in two weeks and pain subsided. Progress *x*-ray films on March 2, 1932, showed destruction of the joint space, bone atrophy and slight destruction of the articular surfaces. Physical therapy was started March 3 with active exercises. She was discharged on March 11, 1932, with a brace which held the shoulder in abduction, and a shoulder which had a marked limitation in motion, but was painless.

When last seen she had been gradually removing the brace and had gained in weight. The motion in the shoulder joint proper was still limited. The arm moved chiefly by scapular motion, but it continued painless.

DISCUSSION

In our experience, aspiration and air insufflation of the knee is the method of choice in the treatment of the serous type of gonorrheal arthritis. Repeated insufflations may be done if the case is refractory, but frequently one is sufficient.

For the periarthritis and pyoarthrosis, immobilization of the affected joint is nearly always necessary because of the associated pain. This is done best in plaster, if that is possible. Failing this, splints are used. The pyoarthrosis should be drained or irrigated as soon as recognized.

Amiodoxyl is started as soon as the diagnosis is made. After a series of six biweekly injections, it is stopped but may be resumed again after two or three weeks. A second series is not often necessary. In mild cases, the use of amiodoxyl in out patients permits patients to be ambulatory. After the symptoms have subsided, the plaster is bivalved and active motion, together with diathermy and massage, is instituted.

We feel that the use of these measures materially shortens the course of the gonorrheal arthritis, prevents massive destruction of the joint and permits more complete restoration of function than measures we have known heretofore. If an acute or chronic urethritis is present, this, of course, should be actively treated at the same time.

SUMMARY

1. Ammonium iodoxy benzoate is of definite value in the treatment of gonorrheal arthritis. It is best used as an adjunct to the usual orthopedic measures: (1) short period of rest, preferably in plaster, for four to ten days; (2) physical therapy: diathermy, massage and active motion as soon as the pain disappears. In the milder cases its use permits a patient to be ambulatory who might otherwise be confined to the hospital.

2. Insufflation of the knee in the synovial type of gonorrheal arthritis is described. We feel it hastens resolution of the process, promptly relieves pain and thus permits early motion, preventing the formation of intra-articular adhesions and muscular atrophy from prolonged immobilization.

3. Aspiration, irrigation or even drainage is sometimes necessary for the purulent type of infection, but amiodoxyl again seems to hasten the resolution and certainly relieves the discomfort. Splinting in a position of rest is necessary for a time, but early motion should be started as soon as the acute stage is over and pain is relieved. With this, diathermy and massage have been found to be the most valuable type of physical therapy.

4. Hyperpyrexia by fever diathermy is useful, especially in refractory cases.

5. Twenty-two cases are reported, 11 of which were treated with the adjuncts already described. Of these 40 per cent were completely cured, 40 per cent much improved and 20 per cent developed ankylosed but painless joints. The remaining 11 are presented for comparison and received neither amiodoxyl, insufflation nor hyperpyrexia therapy. Of these 30 per cent showed no improvement; 10 per cent recurred; 20 per cent resulted in ankylosis; 40 per cent showed slight improvement.

Six cases in which the advocated treatment was used are reported in detail.

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INTERPHALANGEAL OSTEOCHONDROMATOSIS

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OSTEOCHONDROMATOSIS is a rare pathologic process which has been found in joints, tendon sheaths and bursae. We believe the following case is the first report on interphalangeal osteochondromatosis.

Osteocartilaginous loose bodies have been the subject of much interest since Ambroise Paré, 1558, having incised a "watery abscess of the knee," found a "stone as large as an almond, hard and smooth," thus establishing the first pathogenic hypothesis. Under the term osteocartilaginous loose bodies are gathered all the osseous or cartilaginous formations free or encapsulated in joints. The loose bodies arise from three sources:

1. From the diseased tissue which develops in arthritis deformans
2. From the articular surfaces of the ends of the bones
3. From the synovial lining of the joint.

ETIOLOGY

Virchow said in reference to loose bodies: "These formations must be classified in the limits of cartilaginous tumors of hyperplastic and heteroplastic forms." H. T. Jones (1924) is of the opinion that synovial osteochondromatosis may be classified as a neoplasm of a benign nature, and that infection does not play an important part in its formation.

Breuckmann, in 1927, published a complete pathologic study in which he concludes that the histological change of osteochondromatosis manifests itself with a production of hyaline cartilaginous bodies. They are similar to small chondromas which originate in the joint in contact with the synovial membrane.

Lexer advanced the theory that osteochondromatosis is of embryonic origin.

In the 27 cases reported in the literature from 1900 to 1923 only 6 gave a history of trauma. Jones in his review of 19 cases from the Mayo Clinic, 1910 to 1923, shows that trauma figured definitely in 8 cases. However, to judge from the opinions expressed in the literature, trauma plays only a minor role in the etiology of osteochondromatosis.

CASE REPORT

A woman, forty-nine years of age, was admitted to the hospital May 25, 1932, because of a small lump on the second toe of the right foot. In 1922 she noted a small nodule on the lateral border of the second toe of the right foot which caused pain when walking or standing. This small mass was excised with complete healing in seventeen days. A short period later she noted another nodule on the medial aspect, which caused no pain or disability in walking. There is no history of trauma of the foot. Her general health has always been good.

Physical examination revealed a small nodular mass about the size of a walnut, on the plantar and medial surfaces of the right second toe (Fig. 1). The mass was freely movable beneath the skin, with no impairment of function and no tenderness on pressure. The interphalangeal joint moved freely. *X*-ray films (Figs. 2 and 3) of the right second toe showed a nodular shaped shadow, the size of a walnut, on the medial border of the interphalangeal joint of the second toe. The large shadow contained many small circular areas of calcification. The center of these calcified shadows are dense while the margins are hazy and cloudy in outline.

Operation: The patient was operated on May 26, 1932. An elliptical incision was made and the nodule was dissected free. The nodule was attached to the articular capsule of the joint by a pedicle and when this was excised a small portion of the capsule was brought with it, requiring a small suture to repair it.

Pathology: The excised mass, the size of a walnut, has an irregular nodular surface with soft indentations between the outer calcified nodules. It is white in color and has a fibrous

appearance (Fig. 4). The histological examination revealed the bodies to be formed largely of cartilaginous tissue, with varying coloration

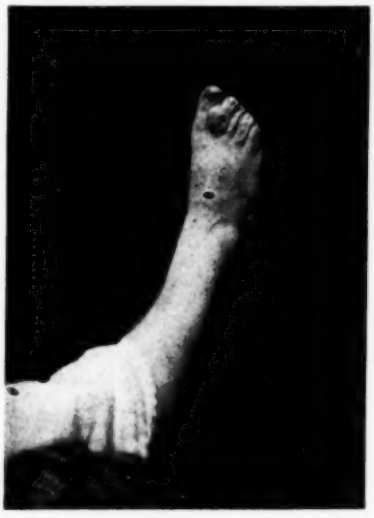

Fig. 1.

in different areas but always of the same type of cells. The cells are round with central or peripheral nuclei embedded in a hyaline sub-

Fig. 2.

stance, staining red or blue. The center of the nodule shows degenerative cartilaginous changes, the hyaline tissue losing most of its basophilic qualities and taking the eosin stain poorly, giving the appearance of a homogenous light blue as if it contained fluid. At this point one sees a cystic formation analogous to the

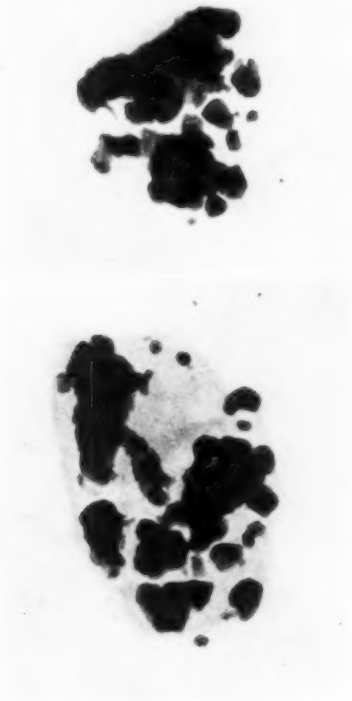

Fig. 3.

hydropic degeneration of the connective tissue. The cells, in the center of degeneration, are without nuclei, while the periphery shows a slight calcification of the cartilaginous tissue, which is formed by underlying layers of vesicular cells and of dark blue granular deposits. The nodules reveal a central concentric arrangement of cartilaginous tissue with blood vessels at the periphery. At irregular points along the periphery there appear small areas of degeneration and absorption of the cartilaginous tissue leading to the center. These small cavities are filled with connective tissue of embryonal character. The cells are round with considerable fluid between them. Some areas are characterized by a degeneration from the center to the periphery where one can see the absorption of the cartilage by the connective tissue cells. The erosion of the degenerated cartilaginous tissue is analogous to the formation of the lacunae of Howship.

The explanation of the central degeneration is not difficult. The central area, being more

devoid of the nutritive fluids becomes necrotic. It is much more difficult to explain the same process as it occurs at the periphery. It is probable that this is due to a continuous slight trauma caused by walking and by the continuous pressure on the toes by the shoes. These traumatic factors affect the superficial areas where there is a proliferation rather than a degeneration. The superficial connective tissue of the mass has fibroblasts of synovial origin and is supplied by the blood vessels coming through the pedicle.

Breuckman in his pathologic study found that the synovial membrane was free from cartilaginous cells and concluded:

(1) Osteochondromatosis is a growth distinct as to origin from all forms of tabetic, traumatic or arthritis articular bodies.

(2) The bodies free in the joint undergo structural modification which probably depends upon the reaction of the synovial fluid. The hyaline cartilage becomes transformed into fibrous cartilage.

(3) A secondary adhesion of the myxoid tissue to the synovial membrane determines the ossification of these bodies.

(4) The growth of these bodies can be observed as a result of precipitation of

Fig. 4.

small cartilaginous masses around its margin.

SUMMARY

The etiology and pathogenesis of osteochondromatosis is still uncertain. From the histological study and its clinical evolution. it can be classified as a new formation of benign character from a metaplasis distinctly different from an arthritic alteration. As a summary of the published cases, the most salient features are reported as follows:

The disease is noted in young, robust individuals in 50 per cent of whom there is a slight history of trauma. It is very slow in its course, latent, and unrecognized by the patient until very late, when there is pain or functional disturbances. It is usually monoarticular and has a particular predilection for the large joints such as the knee and the elbow. The osteocartilaginous bodies can be present at the same time in the articular bursae. They have been found also in the tendon sheaths of the flexor group of the hand. The joint is full of bodies of different sizes and shapes. The synovial membrane is hyperemic and covered with fibrous exudate. The bony extremity is almost always intact.

The histological examination in this case revealed three distinct steps in its formation:

(1) Hypertrophic and hyperemic villi

(2) Villi transformed into pedunculated bodies

(3) Loose bodies.

Breuckman, as we have said, believes that these formations become secondarily pedunculated and become ossified either by the fluid or the membrane.

CONCLUSION

1. This is the first report of interphalangeal osteochondromatosis.

2. Trauma and infection played no part in the evolution of the growth.

3. We believe that its origin is from the synovial membrane, forced to develop externally on account of the small joint space.

4. The osteocartilaginous growth depends upon the secretion of the synovial membrane. Any alteration or imbalance in the secretion of the colloids of the synovial membrane and of the fundamental cartilaginous substances which are embedded in pathological synovial fluid, will bring about a deposit of hyaline cartilage around the synovial cells transforming them into myxoid cells. The changes from the initial and final steps of development in this osteocartilaginous mass are influenced by the type and evolution of the adhesion to the synovial membrane.

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FRACTURES OF THE STERNUM

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MY attention was directed to fractures of the sternum by the appearance of 4 cases within the first eight months of 1932 in the Section on Orthopedic Surgery of The Mayo Clinic. Moreover, since only 4 such cases had been observed previously in the Clinic, it seemed worth while to review our knowledge of the condition and to discern wherein experience of physicians at the Clinic differed from that of other observers. Because of the discrepancy of fractures noted in recent and former years, it seemed advisable to seek the causes.

As is well known, fracture of the sternum is rare. Gurlt, in 1864, studied records of 22,616 fractures of all types treated at the London Hospital during a period of twenty years, and found that only 22 cases of fracture of the sternum had been noted. In the first fifty-four years of the existence of the Massachusetts General Hospital (1811 to 1865) there were but 4 reported cases.[4] Holderman discovered 62 cases in a series of 46,237 cases of fractures in five large metropolitan fracture services. However, past observations of such cases must be reviewed with caution, for, before the days of roentgenograms of the thorax (1896) a diagnosis of this condition depended entirely on gross deformity, crepitus, sharply localized pain, or frequently on observations at post-mortem examination. Even with the rapid development of roentgenography of the thorax, there are still factors which interfere with accurate diagnosis of this condition: (1) generally, there are accompanying injuries (fractures of the vertebrae, injury to the head, or fractured limbs) which divert attention from the sternum; (2) roentgen-ray delineation of this bone is exceedingly difficult, although this has been considerably simplified in recent years by signal improvements in apparatus, and (3) roentgenograms of the sternum made as a routine are unwarranted except in cases in which specific injury is suspected. Consequently, in many cases of accidents undoubtedly there are unrecognized fractures of the sternum that might have been benefited from more specific treatment.

ANATOMY

Anatomically, the sternum is well protected against direct injury in spite of its superficial position. It is surrounded by ligaments and its attachments to the clavicles and seven pairs of costal cartilages on each side are quite elastic and resistant to fracture. The most nearly rigid fixation to the spine occurs at the upper border of the manubrium where the clavicles and first ribs are attached. This is doubtless brought about by the manner of embryologic development of the sternum,* and is a potent factor in causing most fractures in this portion of the bone.

The sternum consists of three parts, the manubrium, body or gladiolus, and the xiphoid process. The upper border of the manubrium supports the clavicles while the costal cartilages of the first seven pairs of ribs articulate with the margins of the manubrium and body. The cartilages of the first ribs fuse directly to the sternum, but for the cartilages of the second to seventh

* The earliest authority (Ruge) held that the human sternum was derived by a union in the median plane of two longitudinal cartilaginous bars which were developed on each side from a fusion of the ventral extremities of the embryonic ribs.[7] More recently Paterson demonstrated the coracoidal origin of the manubrium and shoulder girdle from an encircling primitive band of cellular tissue. This is generally accepted to be true. In 1911 Whitehead and Waddell postulated that the sternum is formed in situ and that the attachment of ribs to it is a secondary phenomenon

ribs, there are present sternocostal cavities or joints with articular capsules (Fig. 1). The manubrium articulates with the body

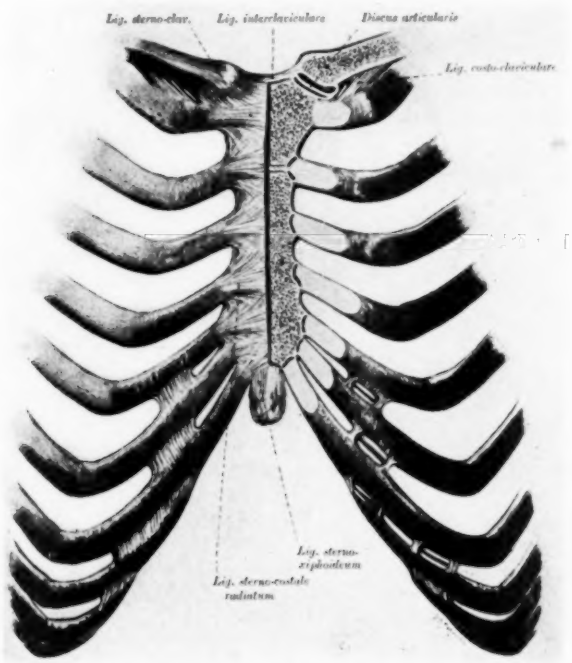

Fig. 1. Sternum, costal cartilages, and sternal ends of clavicles from front. On right side, joint cavities are displayed by frontal section. It may be noted that first rib fuses directly to sternum, whereas all others possess a joint space. (After Quain.)

of the sternum by a dense fibrocartilaginous symphysis at the level of the juncture with the second pair of costal cartilages (angle of Louis).† Anterior and posterior chondrosternal ligaments extend from the ends of the costal cartilages and diverge fanwise on the sternum to interweave with those from the opposite side (Fig. 2). This layer, which ensheathes the sternum in front and behind, is called the membrana sterni. Anteriorly, the sternum is covered by the pectoralis major, sternomastoid and rectus abdominis muscles of each side.

† The prominence of the sternum corresponding to the juncture of the manubrium and body takes its name from the great French clinician, Pierre Charles Alexander Louis (1787–1872). Yet in none of his published writings does he mention this detail. However, in a treatise on emphysema he describes a bulging of the upper part of the thorax which later pathologists and anatomists probably confused with the normal structure now known as the angle of Louis.[5]

Posteriorly the sternohyoid, sternothyroid, transversus thoracis and diaphragmatic muscle fibers are attached.

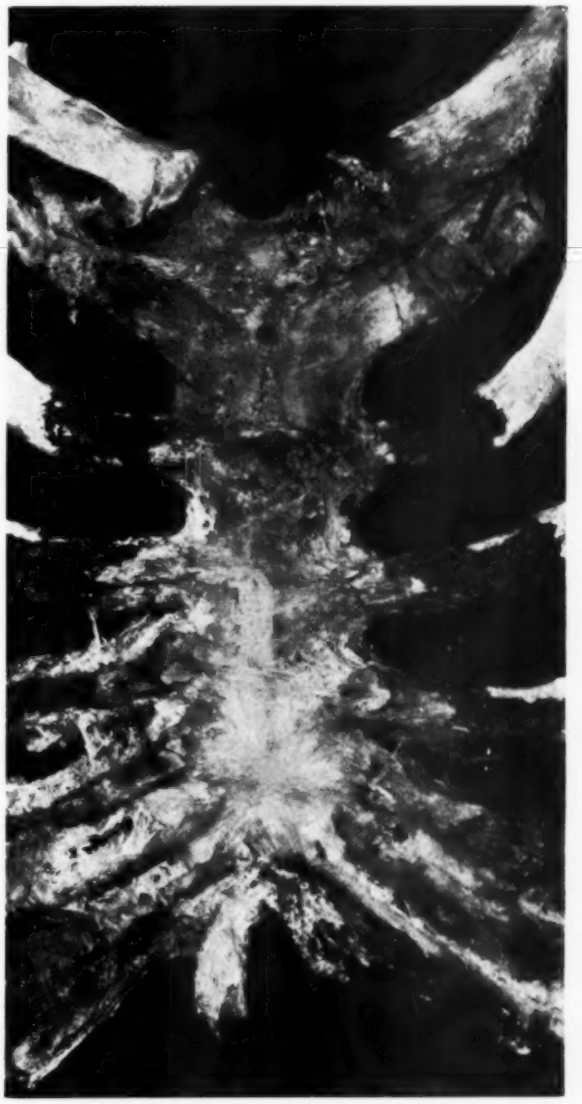

Fig. 2. Sternum, clavicles and ribs, from front. Dense ligamentous covering of entire sternum may be noted.

MECHANISM OF FRACTURE

Fractures of the sternum are produced by direct or indirect injury, usually the former, and follow direct blows to the thorax, crushing injuries, or falls. Force may also be transmitted laterally through the clavicles and produce fracture or, in sudden flexion of the trunk, the chin may strike the manubrium[10] and produce it.[1] The fractures due to indirect injury are produced by abnormal muscular action.

Protracted labor accompanied by intense contractions is a not uncommon cause. A fall backward in which the torso is hyperextended may produce undue strain through the sternomastoid muscles above and the rectus muscles and diaphragm below. As I have mentioned, however, direct injury is the greatest source of this type of fracture.

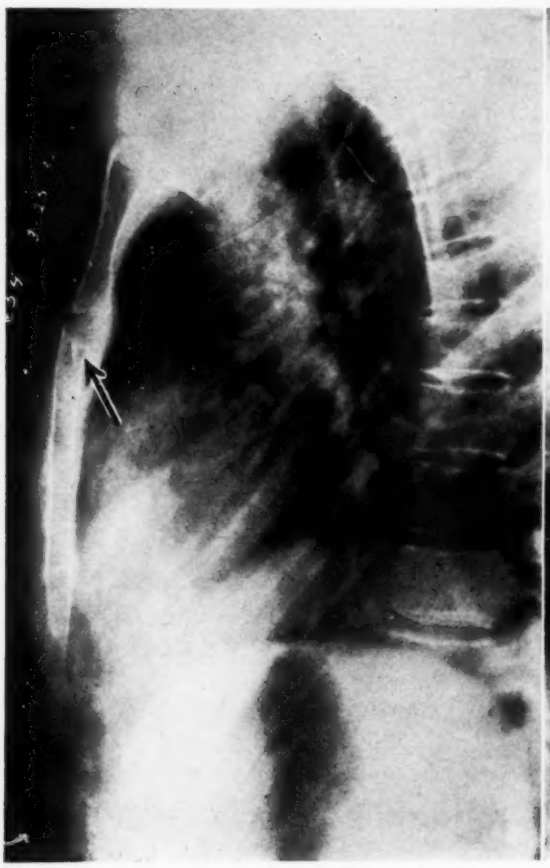

Fig. 3. Roentgenogram of thorax (Case 1). Arrow points to fracture through body of sternum just below juncture of manubrium and body.

Fig. 4. Roentgenogram of the thorax (Case 11). Arrow points to compression fracture of lower edge of manubrium just above juncture of manubrium and body.

The commonest site of fracture is near the juncture of the manubrium and the body, where the bone is thinnest, and where skeletal attachments are more rigid.

As the various portions of the bone are not united until about the age of twenty years, fracture before this time is almost unknown[8] (in the 8 cases observed in the Clinic the average age was fifty-four years). If the sternum of children is injured there may be a dislocation of the manubrium posteriorly to the body, or more accurately, the lower fragment is displaced forward. If the patients are adults, the upper fragment also tends to lie posterior to the lower fragment since the lower is more mobile and is less firmly attached to the axial skeleton.

Blows of sufficient force to fracture the sternum often produce other and more serious complications. Fractures of dorsal vertebrae, ribs, or of the upper extremities are common sequelae. The ligamentous coverings of the sternum protect the fragments so that compound injuries are rare and laceration of the mediastinal contents is ordinarily prevented. However, possible complications include rupture of the internal mammary arteries with resulting hemothorax,[3] partial obstruction of the

trachea, traumatic pneumonia, or laceration of the pericardium.[2]

DIAGNOSIS

In the absence of serious complicating injuries, fracture of the sternum is diagnosed readily by the presence of deformity, crepitation, sharply localized pain, and ecchymosis. The thorax is fixed, breathing is mainly abdominal, the shoulders are drooped forward, and the patient holds his head rigidly to prevent torsion through the sternomastoid muscles. The suspicion of fracture is corroborated by lateral or oblique roentgenograms which will reveal detail of the bone (in anteroposterior roentgenograms of the thorax, the sternum is heavily overshadowed by the spinal column and mediastinum). Pfahler recommended the lateral position as most desirable, with the patient standing, his hands behind his back, the shoulders forced backward as far as possible, and during full inspiration. Köhler suggested that the sternum is ideally depicted by the oblique position from the right posteriorly to the left anteriorly. The detail is more distinct if the patient is lying on his left side so that the heart and aortic arch sink to the left and leave a broad clear space. Either of these techniques or a modification of them is adequate and will portray without difficulty the line of fracture in the bone. One essential, however, is that the respiration should be suspended in inspiration so that a clear space intervenes between the pericardium and the sternum.

TREATMENT

In the older surgical treatises, open reduction of the fracture was often recommended. Or, more bizarre therapeutic suggestions were offered, such as dashing cold water unexpectedly in the patient's face to induce sudden inspiration. However, unless there is direct pressure on the mediastinal contents, conservative measures are more often advised today.

Reduction can be satisfactorily effected by moderate hyperextension with a figure-of-eight bandage across the shoulders, a T splint, or by placing a sandbag between the shoulders. The shallow breathing and localized pain are often relieved by rest and applications of heat. After a week or ten days in bed, the patient can be allowed up if there is no pain in the thorax. Without complications the prognosis is excellent. Healing is rapid (three to six weeks) and, although some deformity may persist, the symptoms subside promptly. Nevertheless violent exercise or heavy lifting may not be accomplished comfortably until two or three months have elapsed.

REPORT OF CASES

Case I. Fracture of the body of the sternum from direct blow. A woman, aged fifty-four years, was riding in an automobile with her husband when it skidded off an icy highway and her husband was so tossed that his knee struck her sharply in the chest. She was brought to the hospital the next day (February 3, 1932) because of sharp pain over the sternum, pain in the shoulder, and inability to take a deep breath. Roentgenograms revealed a fracture of the upper border of the body of the sternum with little displacement (Fig. 3).

The patient was put to bed immediately and local heat applied to the thorax. A week after the injury she was allowed to be up, with a T splint which she used for six weeks subsequently. Recovery was prompt and complete and later, roentgenograms demonstrated good union with abundant callus.

Case II. Fracture of manubrium and concussion of the brain from direct injury. A man, aged fifty-eight years, overturned in his car when the brakes became locked. He was brought immediately to the hospital (May 25, 1932). He was in shock; his scalp was lacerated, and tenderness over the sternum was palpated. Roentgenograms of the sternum showed compression of the lower edge of the manubrium (Fig. 4).

The patient was put to bed and a T splint applied. This became uncomfortable and was removed the next day. Nine days after the injury, he was allowed up. There was no pain. June 6 the patient was dismissed from observation completely recovered.

Case III. Fracture of the body of the sternum from direct injury. A woman, aged fifty-two years, was overturned in a car July 21, 1932, when a tire blew out, and she was thrown against the back of the front seat. She was brought to the hospital because of severe pain in the sternum and left side of the thorax and of difficulty in breathing. Roentgenograms revealed a fracture in the middle of the body of the sternum with little displacement. The tenth left rib was also fractured and there was slight compression of the seventh dorsal vertebra.

The patient was kept in bed for nine days, then allowed to be up and about, wearing a T splint. She was dismissed from observation on the fifteenth day and advised to wear a Taylor back brace to her home in New York and as long as pain persisted in the dorsal vertebrae.

Case IV. Fracture of manubrium and multiple injuries. A woman, aged sixty-seven years, was in a car which skidded around a corner and turned over, throwing her against the side of the car. She was brought immediately to the hospital (August 22, 1932). She had sustained Colles' fractures of both wrists, a long laceration of the scalp and a depressed fracture of the manubrium.

The scalp laceration was sutured, the fractures of the wrists were reduced with the patient under a general anesthetic and plaster casts were applied. The patient was kept in bed for ten days, during which time the scalp wound became slightly infected and early congestion appeared in the bases of both lungs. She recovered rapidly, however, and was dismissed on the seventeenth day. There was no further specific treatment of the sternum although slight pain persisted in the thorax, especially on deep breathing.

As I have mentioned, besides these 4 cases only 4 others, more or less similar, have been observed previously at the Clinic.

The first was that of a painter, aged twenty-nine years, who fell from a ladder, landed on his right arm and cracked the border of the manubrium. In the same year (1919), a ditch digger, aged forty-four years, was brought to the Clinic, who had been crumpled forward by a cave-in. He had a fracture of the manubrium, a slight nasal injury, and bruises about both eyes. The third case was that of a laborer, aged fifty-three years, who was crushed between two road trucks. Fortunately he suffered only a fracture of the body of the sternum. The fourth case was that of a woman, aged seventy-five years, who came to the clinic after a car accident. She was found to have a compression fracture of the fourth and fifth dorsal vertebrae, fracture of the manubrium and a questionable fracture of the base of the skull. All of these patients recovered.

SUMMARY

Although rare, fractures of the sternum probably occur more often than is realized or discovered. They are not diagnosed because serious complicating injuries often accompany them and because they are difficult to depict with the roentgen rays. Anatomically the manubrium is rigidly attached to the vertebral column through fusion with the first pair of ribs. Elsewhere the attachments are more elastic and resistant to fracture.

Fractures of the sternum are produced by direct blows, falls, or crushing injuries. They generally occur in the upper portion of the bone where there is rigid attachment to the axial skeleton. Displacement of fragments is unusual and the ligamentous coverings prevent lacerations of nearby structures. These fractures are diagnosed by deformity, sharply localized pain, crepitation and immobility of the thorax in respiration. Specialized roentgen-ray technique will reveal the detail of the bone, and should be utilized when there is distinct suspicion of fracture in this portion of the thorax.

This type of injury is best treated by rest in bed, local heat and moderate hyperextension. Recovery is prompt and complete, and there is seldom any indication to recommend radical therapeutic measures.

Only 8 cases have been observed in The Mayo Clinic, and 4 of these were seen in the first eight months of 1932.

[For References see p. 273.]

FISTULA OF TRANSVERSE COLON

SECONDARY TO WOUND INFECTION FOLLOWING CHOLECYSTECTOMY

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BECAUSE of its unusual nature, and because a review of the more recent literature on the subject is rather unproductive of similar instances, a case of the writer's is probably worthy of record.

Fistulae of the colon are fairly common complications of abdominal surgery, especially a fecal fistula following an appendectomy in a badly infected field. When stiff rubber tubes are used as drains, pressure necrosis may result with an ensuing fecal fistula. Other fecal fistulae may follow operations when considerable trauma has occurred as a result of direct injury to the large bowel. In this discussion we are not concerned with these types of cases, but rather with those complicated by fecal fistulae which were associated with a severe infection in the operative field. Another fact to be borne in mind is the relatively poor vascularity of the large bowel.

MacLaren[1] briefly records the case of a gangrenous gall bladder which was operated upon and a short time later a fecal fistula developed. The fistula closed spontaneously in three months.

Heineck[2] reports an interesting case somewhat similar to the writer's.

His patient, a female of twenty-six, was operated upon for purulent cholecystitis and chronic appendicitis. There was a wound infection of some grade and difficulty with the drains. Ten days after the operation a fecal fistula occurred. Tape worm segments were also found in the discharging colonic contents. The patient recovered.

The foregoing 2 cases are the only similar cases that we could discover by a careful review of the literature as indexed by the Quarterly Cumulative Index and Index Medicus. No doubt other similar cases have been recorded, but we were unable to find them.

[1] MacLaren, A. *Lancet*, 38: 185, 1918.

[2] Heineck, A. P. *Illinois M. J.* 43: 295, 1932.

CASE REPORT

The patient, J. F. C., a white man of fifty-two years, first consulted me in July, 1930. He gave a history highly suggestive of gall-bladder disease, namely chronic dyspepsia, nausea and vomiting, which were often associated with severe recurrent attacks of epigastric pains. There was no jaundice. Physical examination revealed a large and well-developed individual. The abdominal examination was negative. The only positive findings were chronic dental infection and a large mass of external hemorrhoids. A cholecystogram, the dye being used intravenously, revealed a poorly filled gall bladder. Calculi were not observed. The patient refused operation.

On January 19, 1932, the patient, now in his fifty-fourth year, was brought to the hospital in an ambulance, because of a very recent and violent attack of severe epigastric pain, nausea and vomiting, as well as fever. The temperature had risen sharply to 101°F. He had been acutely ill for several days before coming to the hospital. In the interval he had suffered several attacks of epigastric pain as well as nausea and vomiting. No jaundice was present.

Examination at that time revealed a large and well-nourished man who was acutely ill, and complaining of severe epigastric pain. The temperature was less than 100°F. He was perspiring profusely and nauseated.

The thoracic organs were negative. B.P. 160/80.

The abdomen was full and revealed tenderness in the epigastrium and over the upper portion of the right rectus muscle.

White blood count was 16,800 and hemoglobin 100 per cent (Dare).

The urine was not remarkable aside from a high specific gravity (1.025) and a trace of albumin.

This time the patient willingly submitted to operation for what we regarded as an acute infection in a chronically diseased gall bladder with calculi.

Operation was performed on January 20, 1932, under ether anesthesia. The usual right rectus incision was made. The gall bladder was exposed and found to be small and thickened and moderately adherent about the fundus. In the fundus there was a small area of discoloration partially covered with fibrin which we regarded as a beginning perforation. The region of the neck of the gall bladder was densely adherent and scarred. Much difficulty was experienced in removing the viscus. We were unable to ligate the cystic duct which was accidently avulsed. Fortunately the cystic vessels were thrombosed because no bleeding occurred. Two drains were placed in the wound and the abdomen was closed in anatomical layers with heavy catgut. Stay sutures on buttons were used. The patient was somewhat shocked, but he recovered rapidly following administration of intravenous glucose.

The gall bladder was greatly thickened and leathery in consistency. The walls were 1 cm. in thickness in places. An area of necrosis was found in the fundus at the site of the fibrin deposits already mentioned. A large cholesterin stone was in the cavity. Gross pus was not seen. Microscopically, there was an acute inflammation superimposed on an old chronic reaction.

The patient did very well for about forty hours after the operation, when he developed a fit of coughing which was immediately followed by cyanosis and labored respirations. It was obvious upon physical and *x*-ray examinations that he had an extensive atelectasis of the lower lobe of the left lung. Inhalations of carbon dioxide were given with considerable relief and four days later physical signs, as well as *x*-ray examination, revealed an air-containing left lower lobe. In the meantime the patient was very ill with rather high temperature (101–102°F.) and a tachycardia of 120–130, as well as cyanosis. Respirations were rapid and shallow. There were also signs suggestive of a diffuse bronchitis and perhaps patches of bronchopneumonia. He coughed a good deal and brought up purulent sputum.

The abdomen was persistently distended for days. In the meantime he developed signs of deep infection in the wound and by the sixth postoperative day the temperature reached 103°F. Drainage of bile was profuse for a few days only. On the seventh day postoperative, following the removal of the fine silk sutures in the skin, the wound was found completely ruptured down to the external rectus sheath. The resulting very adequate drainage benefitted the patient a great deal. Pus, however, was slight in amount. Fortunately, the stay sutures were in place and the wound could not completely rupture. The edges of the wound were approximated with adhesive straps and the wound was irrigated frequently with Dakin's solution. The patient's general condition gradually improved, but a slight cough persisted.

During the dressing on February 8, we noticed a small gray patch in the depth of the central part of the wound. On February 9, the twentieth postoperative day, the nurse found the dressings saturated with fecal matter. Upon careful examination, it was found that the entire wound at the site of the fistula had gradually separated; not at the site of the original drainage tract, but several centimeters lower down and between the two stay sutures. A portion of the transverse colon had herniated and was presenting in the wound with a perforation about 1.5 cm. in diameter. Both the upper and lower angles of the wound were healing and the original drainage tract was about closed. The wound was kept clean by frequent dressings and the patient was allowed to go home in a few weeks. He was otherwise in good condition.

After waiting about two and one-half months for the fistula to close, which showed no evidence of closing, we decided to operate. The stoma in the bowel was now at least 3 cm. in diameter. The wound was completely healed above and below the fistulous opening.

On April 21, 1932, under spinal anesthesia the scar tissue and fistula were dissected free and the latter closed with two layers of fine catgut sutures. Omentum was used to cover the line of closure, which was at right angles to the lumen of the bowel. The abdominal wall was loosely closed with catgut and two rubber drains were inserted. Silver wire stay sutures were used.

The patient made an uneventful recovery and was discharged cured May 7, 1932. He has been free of gastric symptoms since the first few weeks following the cholecystectomy. He has a small postoperative ventral hernia.

COMMENT

This is an interesting case of disease of the gall bladder with several major complications, namely atelectasis of the left lower lobe, acute bronchitis and possibly bronchopneumonia, a marked infection in the wound with a resulting rupture thereof followed by a large fistula of the transverse colon. Such a combination of circumstances the writer has never before witnessed. The patient made a very satisfactory recovery. The wound infection undoubtedly arose from the gall bladder, which was gangrenous in a small area.

Why did the fistula of the transverse colon occur? There certainly was no injury to the large bowel at operation or the fistula would have occurred earlier in the postoperative convalescence. Furthermore, the colon and other structures were protected as usual by gauze pads. It appears that the fistula was directly related to the infection in the wound and in this respect similar to the 2 other cases already referred to. When the wound completely separated between the stay sutures, a small portion of the transverse colon undoubtedly pushed through the opening. How long the bowel was partially herniated we do not know, but the day before the fistula appeared a small grayish patch about 1 cm. in diameter was noticed in the depths of the wound. That must have been an area of beginning necrosis in the wall of the bowel which next day perforated and gradually grew to about 3 cm. in diameter. The constant intra-abdominal pressure on the herniated bowel in a constantly infected field no doubt led to necrosis in the bowel, the blood supply of which is none too good. It was this combination of factors which probably produced the fistula. It is highly unlikely that the Carrel-Dakin's solution was in any way responsible for the perforation. The fistula had to be closed surgically because it showed no signs of doing so spontaneously, as is so often the case with smaller colonic fistula.

It is also important to record that the atelectasis of the left lower lobe of the lung was probably caused by a mass of tenacious sputum plugging the main bronchus to that lobe. The atelectasis, judging from the signs and symptoms, developed just before or after the violent fit of coughing. The sputum in this case was very tenacious and rather abundant. The patient responded nicely to hyper-ventilation of the lungs with carbon dioxide.

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*Continued from p. 270.

COINCIDENT HEMORRHAGE AND PERFORATION IN CHRONIC DUODENAL ULCER*

JOHN BURKE, M.D., AND CLARENCE KUMMER, M.D.

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THE treatment of acute and profuse hemorrhage of gastric origin is, according to the texts, essentially medical. There is a slightly more radical school of thought which believes primary surgical intervention to be justified when the presence and location of an ulcer has been determined previous to the accident. Finsterer,[1] who represents the most radical school, feels acute hemorrhage to be as definite an indication for surgical therapy as is perforation.

A study of the literature of the past decade would indicate that the coincidence of hemorrhage and perforation is rare. Behrend[2] heads his paper: "Protocol: Perforated ulcers rarely bleed. Bleeding ulcers seldom perforate." His anatomical studies of the pylorus region explain the relative infrequency of coincident hemorrhage and perforation in duodenal ulcer. Finsterer, however, from the study of his own material and that which he has assembled from the world literature, feels this coincidence is not unlikely, and is a definite and additional indication for surgical therapy in gastric hemorrhage. Berg[3] has recently reported several cases of perforation and hemorrhage although the hemorrhage was not severe. In several other case reports wherein hemorrhage and coincident perforation were cited, the use of the word hemorrhage was slightly far-fetched. The relative paucity of reported cases of severe hemorrhage complicated by perforation has prompted us to report the following case:

L. K., aged fifty-three, painter.

The patient consulted one of us September 12, 1932, complaining of abdominal pain one to one and one-half hours after meals, which he had noticed for the past three or four months. His family history was irrelevant, and he did not remember having required the services of a physician before in his life. The present complaint began three or four months ago with pain in the upper abdomen which followed the ingestion of food one to one and one-half hours. It was relieved by soda bicarbonate or by the taking of more food. About the same time he began to have a feeling of discomfort in the left chest which extended through to the back. This was a sense of pressure rather than pain, and was worse with exertion. He had always been slightly constipated.

The following is an abstract from the record of his examination at that time:

The patient is pale and appears malnourished. His teeth are in wretched condition. There is no lead line. The lungs appear normal. There is an enlargement of the heart to the left (confirmed by fluoroscopy). The abdomen is very tender in the midline above the umbilicus. No masses are felt on palpation. The peripheral arteries are very hard. There is no wrist drop. B.P. 222/148; pulse 92. Laboratory findings: Urine negative. Urea nitrogen 19.7 mg. Wassermann negative. R.B.C. 4,210,000, hgb. 84 per cent (Sahli). Six blood smears examined for basophilic stippling were negative. A twenty-four hour urine specimen was negative for lead.

The patient was placed upon a bland diet, and given an alkaline powder with the addition of 1/200 gr. of atropine sulphate t.i.d.

The patient was seen again September 16, 1932. At this time he said his stomach felt fine, and although the pain in his chest was

[1] Finsterer, H. Die Operative Behandlung der akuten profusen Magen- und Duodenalblutungen. *Wien. klin. Wchnschr.*, 44: 1125; 1160; 1185, 1931.

[2] Behrend, M. Incidence of hemorrhage in perforated gastric and duodenal ulcers. *J.A.M.A.*, 95: 1889–99, 1930.

[3] Berg, B. N. Coexistence of perforation of bleeding duodenal ulcers. *S. Clin. N. America*, 11: 543–545, 1931.

* From the Central Park Clinic.

still present, he thought it had no relation to exercise. The blood pressure was 200/138, and a pulsus alternans was discovered while the reading was being taken. He was advised to go to bed, and continue the diet and alkali therapy. September 18 at 5:30 A.M., we were summoned to the patient's home, as he had had a profuse hematemesis. Morphine was administered and ice bags applied to the abdomen. There was another severe hematemesis the following morning and the patient was admitted to the clinic by ambulance.

When seen upon admission he was thin, pale and worried looking. The skin was cool and moist to the touch. The pulse was 115, temperature 97.6°F. and blood pressure 95/50. He presented the picture of acute and severe blood loss. The mucous membranes were pale. There was no lead line. Examination of the head, neck and chest revealed no significant abnormalities. The upper abdomen was somewhat distended, and felt rather doughy. A definite gurgle was obtained on palpation over the stomach, and it seemed as if the stomach outline could be palpated. There was but slight tenderness on epigastric palpation, and rectus spasm or resistance was absent. The liver, spleen or kidneys could not be palpated. The reflexes were present and active. There was no wrist drop. At this time the red corpuscles numbered 2.44 million, with 50 per cent (Sahli) hemoglobin. The urine examination was negative.

A hypodermoclysis of 1000 c.c. saline was given immediately and intermittent gastric lavage with an inlying duodenal tube was begun. Five cubic centimeters coagulin were given. Three hundred fifty cubic centimeters of old blood were removed at the first syphonage. Adequate morphia was given to allay restlessness. At 8 P.M. there was emesis of 150 c.c. dark brown fluid, markedly positive for blood. The lavage was discontinued.

September 20, 1932. There was a complaint of slight pain in the left back and shoulders, but physical examination gave no additional clue to its etiology. There was no emesis.

September 21, 1932. R.B.C. 1.73 million, hgb. 20 per cent (Sahli). A transfusion of 350 c.c. citrated blood was given. This relatively small amount of blood was given because it was feared that more might increase the blood pressure to the point of starting the bleeding anew. There was no emesis. Stools were, of course, black and tarry.

September 22, 1932. The patient's condition seemed greatly improved.

September 23, 1932. The improvement continued until evening when there was emesis of 700 c.c. dark red fluid. The pulse became weak and irregular, but strengthened with supportive treatment.

September 24, 1932. The blood count had fallen to 850,000 with a hgb. of 20, and a transfusion of 500 c.c. citrated blood and a hypodermoclysis of 1000 c.c. normal saline solution were given. There was distinct improvement following the transfusion although the patient again complained of pain in the shoulders.

September 25, 1932. The condition was unchanged. Shoulder pain was still in evidence. The abdomen was soft and not particularly tender to palpation.

September 27, 1932. Condition was unchanged. A modified Sippy diet was begun.

September 30, 1932. The pain in the chest and shoulders was still present. In the evening a complaint was made of severe abdominal pain. The general condition was very poor. The abdomen was soft and not distended.

October 1, 1932. The patient's condition has declined steadily. The abdomen, while soft, was quite distended below the umbilicus. Hot stupes and a rectal tube did not relieve the distention. The possibility of a perforation into the lesser omental bursa was considered as a likely explanation for the abdominal pain and lack of signs of peritoneal irritation. The patient's condition made operation impossible, except for purposes of euthanasia. His progress was steadily downward, and death occurred at 9 P.M.

Note: Morphine had been used intermittently throughout the illness. The fluid intake was maintained at 2000 c.c. The temperature at no time was above 99.5°F.

An autopsy was performed two hours post mortem. When the peritoneal cavity was opened it was found filled with a turbid, purulent fluid. The intestines were injected and matted together by exudate. A perforation about 1.5 cm. in diameter was seen just distal to the pylorus on the anterior surface of the duodenum. Its upper border was at the pyloric ring. A small artery plugged by a recent thrombus presented at the bottom of the crater, arising from the distal wall of the ulcer.

[Concluded on p. 278.]

DIVERTICULITIS OF THE CECUM*

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NEW YORK CITY

DIVERTICULITIS of the cecum is a condition rarely encountered in the practice of abdominal surgery and when it does occur a correct diagnosis is practically impossible and almost invariably a diagnosis of appendiceal abscess is made. Isolated cases have been reported (French, Jackson, Moschowitz, Cook, Greenfelder, Hiller and Wilson). Hiller reported 4 cases of diverticula of the cecum, but they were traumatic in origin and not acquired. Two occurred in 5385 operations and 2 in 400 autopsies.

While diverticulitis of the cecum is a rare condition, diverticulosis of the large intestine is not uncommon. W. J. Mayo in 1930 reported a group of 2139 cases of which 5 to 7 per cent of all colon examinations revealed diverticula. Spriggs and Marxer in 1000 consecutive radiologic examinations of the colon recognized 100 cases of diverticula; 29 of which were in women and 71 in men. The distribution of these 100 cases was as follows: Pelvic colon, 58 cases; descending colon, 46; iliac colon, 16; transverse colon, 13; ascending colon, 10; whole colon, 8; cecum, 7; appendix, 5; rectum, 3.

Following the Mayo classification of diverticulitis, the most common type is one where the inflammatory process is limited only to the wall of the sac. The patient complains of recurrent attacks of abdominal soreness, cramps, irregular bowel habits and gas formation. Radiologic examination of the colon reveals definite pocket formation. The treatment is mostly palliative, excluding all coarse and indigestible food in the diet, and the taking of a daily dose of mineral oil. Local application of heat and tincture of belladonna will relax the bowel spasm and control the pain. The patient should be cautioned against cathartics and large enemas (bowel flushing) as both are very harmful.

Instead of being self limited, the process may extend further and become acute, sudden in onset, and go on to perforation and peritonitis. The picture in general is that of an acute abdominal process, resembling a ruptured appendix with peritonitis, except that the process is on the left side. The treatment of course is operative.

Diverticulitis might present still a different picture. The process may be chronic with recurrent attacks of local peritonitis, resulting in adhesions, and leading to partial or complete intestinal obstruction, giving rise to symptoms depending upon the degree of involvement. There may be signs and symptoms of left sided local peritonitis, or of chronic or acute ileus. The treatment of this type of peridiverticulitis would likewise depend upon the clinical and pathological findings. The local peritonitis is treated expectantly and palliatively, and operative treatment is instituted if the process becomes acute or interferes to a serious degree with intestinal function.

More rarely the case of diverticulitis and peridiverticulitis may be complicated by abscess formation, resulting in an enterointestinal, enterovesical, enterocolic, or other fistulae. Local abscess formation beneath the bowel may give symptoms similar to a perinephritic or appendiceal abscess. The occurrence of an extraperitoneal abscess formation is, at times, hard to account for and if its relation to diverticulitis be kept in mind it might help to explain its origin.

To complete the Mayo classification of

* From the Surgical Service of Lincoln Hospital, Dept. of Hospitals, New York City, Dr. Kirby Dwight, Dir.
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diverticulitis, two more types are to be mentioned, viz., diverticulitis associated with obstruction of the bowel, and diverticulitis with carcinoma. In the former, the pathological process is one of inflammation of the bowel wall around the diverticulum, resulting in fibrosis of the bowel wall and narrowing of the lumen of the bowel. The symptoms are that of a tumor and indeed a differential diagnosis from carcinoma is not easy and may be impossible to make.

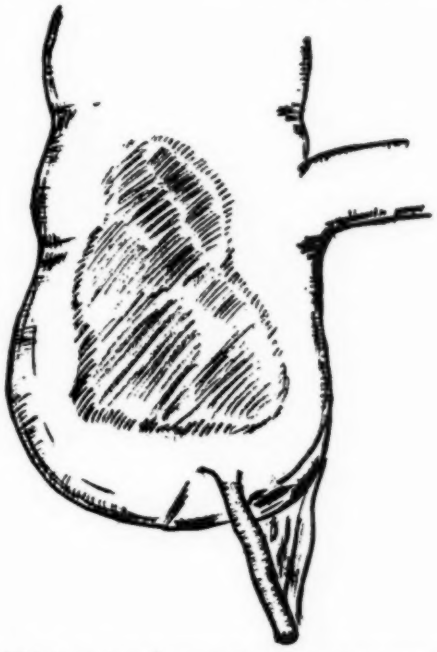

Fig. 1. Thickened and congested part of cecum making up mass which was felt on abdominal examination.

The etiological factors and the anatomical arrangements of the colon and the development of diverticula will not be considered. The writings of Edwin Beer, Hartwell and Cecil, Watson, Spriggs Telling, Judd and Pollack, Case, Ranken and Brown, and W. J. Mayo may be referred to.

The following case will therefore be of interest from the standpoint of incidence and diagnosis.

Mrs. J. D., aged sixty-two, Porto Rican housewife, was admitted to Lincoln Hospital Dec. 13, 1932. A thorough history was not obtained. For some time prior to admission, the patient had indefinite abdominal complaints, chiefly constipation and gas formation. Three days prior to admission, she began to complain of abdominal pain which localized itself in the right lower quadrant. There was no nausea or vomiting, she had had no bowel movement since the onset of the present attack, three days prior to admission to the hospital.

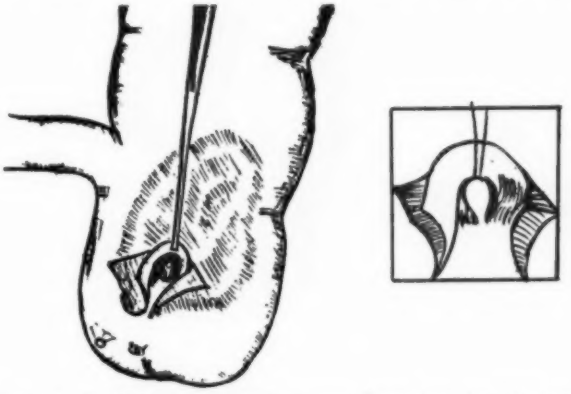

Fig. 2. Reflexion of peritoneum exposing herniation (insert). Diverticulum dissected out.

Physical examination showed the patient to be an elderly female rather poorly nourished. Head, neck and chest revealed nothing abnormal except for the degenerative processes associated with an aged patient. The abdomen was rather flabby, muscles not rigid but there was definite muscular resistance in the right lower quadrant with a definite outline of a mass and extreme tenderness at McBurney's point.

Temperature on admission was 100.5°F.; pulse 95, blood pressure 110/60; W.B.C. 6000; with polymorphonuclears 67 per cent; the urine was negative.

A diagnosis of a walled-off appendiceal abscess was made and the patient was sent to the operating room.

Under local anesthesia a 3 inch lower right rectus incision was made and the abdomen opened. The appendix showed mild serosal injection measuring 3½ inches by ¼ inch, but was found not to be the seat of pathology. The anterolateral surface of the cecum (Fig. 1) was greatly thickened and congested, making up the mass which was felt on abdominal examination. The actual inflammatory area measured about 2½ and 1½ inches in diameter. It was firm, smooth and regular to touch and partially adherent by fresh adhesions to the parietal peritoneum of the right lumbar region. It did not appear to be malignant in nature but it was thought advisable to obtain a biopsy

for pathological examination. Accordingly, the mass together with the appendix was brought out of the abdomen, the appendix was removed in the usual manner, the peritoneum covering the most thickened part of the cecum was incised and undermined on each side. In doing so, the actual pathological condition was exposed, a line of cleavage was noticed, and a small mass, proving later to be a herniation, was dissected out (Fig. 2). The diverticulum measured ½ inch in length, ¼ inch at its fundus and communicated with the lumen of the bowel by a definite neck measuring about 1/16 inch in diameter.

The diverticulum was removed, a purse string suture was then applied around the small opening and the stump inverted. The incised peritoneum over the mass was then closed with interrupted Connell sutures. The abdomen was closed without drainage.

Pathological examination revealed muscular, fibrous and loose areolar tissue, infiltrated by acute inflammatory cells. Part of the section showed glands with columnar epithelium resembling that of the intestine. Pathological diagnosis was acute diverticulitis of the cecum.

The patient made an uneventful recovery. Radiologic examination of the large bowel before discharge from the hospital revealed no other diverticula.

CONCLUSION OF DRS. BURKE AND KUMMER'S ARTICLE*

There was marked callous induration surrounding the perforation. No other gastric lesions were found other than a mild gastritis involving the antrum. The kidneys were typically arteriosclerotic, and the arteries throughout the entire body were like pipe stems in consistency.

The anatomical diagnosis was: Chronic duodenal ulcer with hemorrhage and perforation; acute peritonitis; generalized arteriosclerosis.

Comment: At the time of admission, operation was considered, and deferred in the presence of active hemorrhage. At no time did the patient's condition improve sufficiently to encourage operative therapy. If, however, we had interpreted the back and shoulder pains as indicative of approaching perforation, the risk would have been undertaken. The accepted opinion concerning the rarity of perforation with acute hemorrhage, together with the relative lack of physical signs, put us off guard until it was too late.

SUMMARY

A case of chronic duodenal ulcer with acute and profuse hemorrhage, followed by perforation into the free abdominal cavity is reported, together with the post-mortem findings.

* Continued from p. 275.

ACUTE APPENDICITIS INCIDENTAL TO OMENTAL INGUINAL HERNIA AND UNDESCENDED TESTICLE

FRED K. GARVEY, M.D., F.A.C.S.

WINSTON-SALEM, N. C.

THE following case presented and was operated upon because of a painful tumor mass in the inguinal region. No preoperative diagnosis was made though suspicion pointed toward an acute condition of an undescended testicle, with a possibility of an accompanying incarcerated inguinal hernia. Appendicitis was not considered before operation, yet the symptoms could be attributed to it were it not for the misleading history and the marked gross abnormal findings in the inguinal region, namely, a bulging mass and the absence from the scrotum of the right testicle; also the presence of pain in the tumor mass.

Mr. A. P. aged twenty-six, a truck driver, was admitted as an emergency case complaining of pain of a constant dull aching character in the right lower abdomen, particularly in the inguinal region. Frequently sharp shooting pains radiated over the iliac region, and occasionally up to the epigastrium. Nausea and vomiting were present. He had had three to four such attacks, previously, at intervals of about four months. He claimed to have ruptured himself just before the first attack by carrying 100 pounds of plaster and to have had a bulging in this side ever since, but more marked since the last attack. His appetite was poor but bowels were normal. There was no history of chills or marked fever. The right testicle had always been absent from the scrotum. His past history was negative as to serious illness or operations.

Examination revealed a well-developed and nourished man, not markedly ill, with a temperature of 100°F.; pulse 78, and respiration 20. There was a marked bulging of the lower abdomen over the region of the internal inguinal ring. There was also some tenderness and rigidity over this region.

The right testicle was absent from scrotum and could not be identified in the inguinal canal, though a mass could be felt just outside the internal ring, which was not very firm. No impulse was elicited on coughing. The mass was not tympanitic to percussion. There was no general abdominal distention.

Laboratory tests showed a blood count of 11,700 white cells with a differential of 77 per cent polynuclears, and 23 per cent lymphocytes. The urinalysis showed a few pus cells in the second glass, with a trace of albumin. No red blood cells were present.

Operation was performed the following day under general anesthesia. The testicle was found to be very small, lying high in the inguinal canal. There was no evidence of torsion or inflammation present. A fairly large omental hernia was protruding through a moderately enlarged ring. No evidence of strangulation was present and it was replaced easily. Because no acute pathological condition was present in the hernia or testicle to account for the sudden illness, the appendix was investigated through the ring. The caecum was in the normal position, but on delivery through the opening the appendix was found to be swollen, reddened with congestion and at the tip was almost gangrenous, being plastered down to the ascending colon by a yellow exudate.

Appendectomy was done, the hernia sac removed and the testicle brought down and fixed in the scrotum. The patient was immediately relieved of symptoms and rapidly went on to an uneventful recovery.

The pathological report, microscopically, showed the appendix to be acutely infected.

MULTIPLE NEURITIS FOLLOWING BILIARY TRACT OPERATIONS

FREDERICK CHRISTOPHER, M.D., F.A.C.S., HARRY A. PASKIND, M.D. AND LOWELL D. SNORF, M.D.

EVANSTON, ILL.

ACCORDING to Pollock[1] the causes of multiple neuritis

> . . . may be grouped as toxic, infectious and unknown. Among the most common *exogenous toxins* are alcohol, lead, arsenic, coal-tar products, carbon monoxide, nitrobenzol, mercury, copper, zinc, phosphorus, silver and emetin. The *endogenous toxins* develop during diabetes, the cachexia of tuberculosis and syphilis and beri beri. The *infectious diseases* which most often play an etiological role are diphtheria, influenza, typhoid fever, measles, scarlet fever, whooping cough, puerperal fever, septicemia, parotitis, gonorrhea and syphilis. Acute infective polyneuritis, acute febrile polyneuritis and infective neuronitis, may also be causes. There are in addition various unknown factors.

Recently Wechsler[2] reported 8 cases of multiple neuritis after prolonged vomiting, gastrointestinal disturbance or restriction in diet. This writer suggested that the cause of the multiple neuritis in these cases might be some form of avitaminosis. Multiple neuritis may develop following severe vomiting of pregnancy.

In this connection the work of Randoin and Lecoq[3] is of interest. These writers state that earlier studies have demonstrated the existence of two vitamins B, one essentially antineuritic, the other primarily nutritive. Distillery yeast furnishes the latter almost exclusively while beer yeast contains both. It has been shown, moreover, that the nature of the glucides in the diet have an influence on the development of total avitaminosis B. They reported experiments carried out on three lots of pigeons on basic diets respectively of purified dextrine, pure glucose and pure galactose. Comparative study was made of the effects of the addition of beer yeast or distillery yeast on the one hand and the effect of the addition of extract of beer yeast on the other hand. It was found that the presence of the two vitamins B in sufficient quantity in a completely balanced artificial diet does not prevent in all cases the appearance of acute polyneuritic crises. If galactose is the sole sugar in the diet, a large daily dose of beer yeast fails to prevent the nervous symptoms and death occurs in fifteen to twenty days. If the same quantity of glucides is supplied by pure glucose, a larger proportion of vitamins B is required. A slight insufficiency of the two vitamins produces a long illness, characterized by severe crises and apparent cures, with several recurrences. This condition of recurrent polyneuritis ends in death. An insufficiency of the antineuritic vitamin alone brings about a condition of chronic multiple neuritis.

In 1910 Kohn[4] reported a case of multiple neuritis following a gastroenterostomy. The patient had suffered for years from severe gastric symptoms. There was progressively more frequent vomiting and severe emaciation. A diagnosis of gastric ulcer was made and gastroenterostomy carried out. Shortly after this operation which was followed by repeated saline infusions and the gradual administration of food acute multiple neuritis developed. The patient eventually recovered almost completely. Kohn was unable to find a report of a similar case in the literature. It is not improbable in this case that the prolonged vomiting before operation was an important etiological factor.

Cases of multiple neuritis following biliary tract operations are uncommon as a search of the literature disclosed but one case. In 1925 Cornils[5] reported the case of a woman of forty-six years who was

operated upon for what the author called an aseptic occlusion of the common bile duct by a gallstone with a jaundice of two months' duration. Signs of "cholemia" set in and in a few days a universal polyneuritis developed. The patient was regarded as a moribund but recovered after transfusion of a liter of blood. The multiple neuritis lasted for a year.

The following two cases are thought to be of sufficient interest to warrant reporting:

Case 1. Patient Mary S., aged forty-three, was admitted to the Evanston Hospital on October 18, 1932. After a period of observation and study by Doctors Carr, Danforth and Corbus an exploratory laparotomy was done by one of us (F. C.) on November 1, 1932, with a preoperative diagnosis of liver abscess or cholecystitis. Liver abscess was not found but an empyema of the gall bladder with cholelithiasis was found. The gall bladder was removed and the peritoneal cavity was drained. A stormy convalescence followed. Gastric dilatation required frequent gastric lavage. The abdominal incision became infected and had to be opened up widely. Impending evisceration was guarded against by strapping the wound with adhesive. Vomiting and nausea were persistent. Proctoclysis of 1 per cent dextrose solution, generally about 1,000 c.c., was given daily for the first forty days postoperatively. Hypodermoclyses of dextrose, Ringer's solution and saline were given on the tenth, twelfth, fourteenth, fifteenth, sixteenth, seventeenth and twentieth to thirty-fifth days postoperative inclusive, the amount of solution being generally 1,000 c.c. The net oral intake (water) from the fourteenth to the twenty-ninth day averaged about 100 c.c. daily. On the thirtieth day postoperative the patient's stomach became more tolerant and although emesis continued until the forty-first day, and a few times thereafter, the net oral intake rose rapidly and by the forty-fourth day the patient retained 1,620 c.c. of oral intake. From then on surgical recovery progressed rapidly. The wound healed and the patient's general condition improved. On about the fortieth postoperative day, however, the patient first began to complain of weakness and pain in the legs. One of us (H. A. P.) first saw her on December 13, 1932, the forty-second postoperative day. At this time it had been noted that there had been a rapid onset and development of weakness of the legs of the previous three days; weakness in the hands and arms of one to two days' duration; intermittent pains in the legs for twelve to fifteen days previously.

For a few days previously there had been painful tingling and clumsiness in the fingers. Lancinating pains in the legs developed a few days later, lasted about three or four weeks and then gradually disappeared.

The patient when first examined neurologically showed symmetrical motor and sensory loss and hyporeflexia in all four extremities; these findings rapidly became more marked and by the fifty-second postoperative day the following objective neurological signs were present:

There was bilateral foot drop and wrist drop. In addition flexion of the thighs upon the abdomen was weak; flexion of the legs upon the thighs was extremely weak; extension of the legs upon the thighs was impossible; rotation, abduction, eversion of the feet were absent; flexion and extension of the toes were gone. Adduction and abduction of the thighs were absent. The muscles of the hand and fingers innervated by the median and ulnar nerve were all paretic, but motion of these muscles was never entirely lost. Flexion and extension of all joints of the hands were defective.

There was tenderness over some of the nerve trunks of the arms and legs. The feet and hands were tender to pressure. Fork was not felt in the hands and feet, position sense was absent in the toes. Sense of pressure and pressure pain were absent in those parts of the calf not tender to pressure. Sensation to cotton, pin, heat and cold was deficient or absent over the feet and legs as high as the knees, and over the hands and lower third of the wrists.

Ankle jerks, wrist jerks and knee jerks were absent. The biceps and triceps jerks were present, but feeble. Plantar stimulation gave no response. The abdominal reflexes were not elicited.

There was distinct atrophy of the flexors and extensors of the leg, and in the flexors and extensors of the feet. Atrophy of the extensors of the wrist was marked, but the flexors of the wrist and the interrosei were also wasted to some degree. The finger nails showed no changes. There was slight hyperkeratosis over the balls of the feet.

Cranial nerves were intact. Bladder and bowels were not affected.

All findings were bilaterally symmetrical.

When first seen the patient was depressed, wept easily, was unusually fearful and her fears could not be assuaged by persuasion. These symptoms gradually became worse, and about four weeks after the onset of the above symptoms she went into a state of hallucinatory confusion which lasted about ten days, then for several days she showed typical Korsakoff phenomena; she was completely disoriented, memory for recent events was completely gone, and she confabulated extensively; these symptoms gradually cleared up.

On the basis of the foregoing findings the diagnosis of multiple neuritis was made. The slow course of her illness is characteristic. At this writing, six months after the onset of the neuritic symptoms, motion about the wrist and fingers shows considerable return, the symptoms of the lower extremities show only very little improvement.

Case II. Patient Ruth B., aged fifty-one, was admitted to the Evanston Hospital on January 6, 1933, with a history of periodic attacks of right upper quadrant pain associated with jaundice. The patient was not jaundiced at this time. There was absence of shadow in the Graham-Cole test. At operation done by one of us (F. C.) January 7, 1933, the liver was found to be rather small and scarred at the border. Numerous adhesions were present and the gall bladder, which was only about 1⅛ inches in length, contained several large stones. The common and hepatic ducts were widely dilated and contained several large stones. The gall bladder was not removed but after removal of the stones a "T" tube was placed in the common duct in such a manner that one end of it protruded into the duodenum through the ampulla of Vater. The postoperative course was stormy and critical and the "T" tube was removed on the sixteenth day, when a whole blood transfusion was given. The fever went as high as 103° F. and the pulse 140. Vomiting was frequent and lavage was often employed. Subcutaneous and rectal fluids were administered daily. In the third postoperative week the vomitus averaged 300 to 400 c.c. daily. On the thirty-second day a high jejunostomy was done and feeding with Scott's food was begun and other nutritive fluids as suggested by one of us (L. D. S.). All vomiting stopped by the forty-third day. The patient soon began to eat well and the enterostomy was discontinued on the fifty-sixth day from the original operation. The wounds healed satisfactorily.

On about the thirty-eighth to fortieth postoperative day the patient began to experience sharp, shooting, momentary, "hot poker" pains in the arms and legs, worse in the legs. The pains were not continuous, but sometimes they were paroxysmal. With the onset of the pains there was a gradual onset of weakness in the arms and legs, and numbness in the hands and feet. There were no bladder or bowel disturbances. When first seen by one of us (H. A. P.) on the fifty-seventh postoperative day neurological examination showed the following:

Dorsal and plantar flexion was present in all toes except in the great toes of each foot. Dorsal flexion of the feet was weak; she was unable to dorsiflex feet with the weight of the hand interposed as a load. Plantar flexion of the feet was weak. Flexion and extension of both legs upon the thighs was very weak. Movements about the hip were well performed. Adduction, abduction of the thighs, and internal and external rotation of the legs were well performed. All movements of the upper extremities were well carried out except that extension at the wrist and extension of the fingers were weak.

The feet, calves, hands and fingers were tender to touch and pressure. Pressure over the nerve trunks of the legs caused pain. There was diminution or absence of all forms of sensation in some of the parts innervated by the tibial, external popliteal, long saphenous, short saphenous, radial, median and ulnar nerves.

Plantar stimulation produced flexion of the toes. The ankle jerks, knee jerks, and wrist jerks were absent. Triceps and biceps jerks were present and normal. Only the left upper abdominal reflex was elicited.

Cranial nerves were intact.

There was considerable wasting in the dorsal interossei of both hands.

There were no mental changes.

All findings were bilaterally symmetrical.

The condition became gradually worse and by the seventieth postoperative day there was complete bilateral foot drop and wrist drop.

This case was also considered to be one of multiple neuritis. The course of the illness has been extremely slow. At this writing, four

months after the onset, there is considerable return of motion in all extremities, but all afflicted parts are still weak.

DISCUSSION

It seems highly probable that some form of avitaminosis was the cause of the multiple neuritis in these cases. In the first case doses of sodium cacodylate were given but the amount of arsenic thus administered would seem to be unimportant. The glucose solutions used in both cases were found to give negative tests for arsenic and selenium. Marked infection was present in both cases but the drainage was free and not comparable with the degree of infection in many cases in which no multiple neuritis developed.

CONCLUSION

1. Two cases of multiple neuritis are presented which followed prolonged postoperative vomiting.

2. Surgical patients in which there is a stormy convalescence and prolonged vomiting should be given the benefit of an early jejunostomy in an effort to prevent the occurrence of multiple neuritis.

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PERFORATED SIGMOIDITIS WITH GENERALIZED PERITONITIS

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IN 1898 Regnier first reported a case of perforating sigmoiditis. That same year Graser presented a case of left-sided peritonitis due to an inflamed diverticulum of the colon, and established diverticulitis as a surgical entity. In 1907 Patel collected 8 cases. Since then this same author assembled 28 cases from the literature up to 1911. In 1931 Eggers reported 24 personal cases of diverticulitis of which number there were 7 cases of perforation. Of the 7 cases there were 3 with localized abscesses, and in 4 the perforation occurred into the peritoneal cavity resulting in generalized peritonitis. Haines reported one case of perforating diverticulitis with cure following drainage.

PATHOLOGY

Upon opening an abdomen harboring this type of lesion, one finds free pus in the peritoneal cavity. The sigmoid is covered with an inflammatory exudate. In those cases where the perforation could be found it was noted to be small and it was detected only after the most careful examination. In many of the reported cases the perforation could not be found at operation because of the excessive exudation. A typical perforation has an uneven and gangrenous margin, and usually opens into the peritoneal cavity. At times it leads into an abscess cavity which is situated between the serosa and muscularis, and communicates with the peritoneal cavity through a second opening. The usual site of such a perforation is the movable segment of the sigmoid (antimesenteric border), although it may occur on the lateral wall or the mesenteric border of the gut. Cases have been reported where the perforation was situated in the apex of a diverticulum. It has been stated that the fat tags on the lateral mesenteric border of the gut are most frequently involved.

The affected segment of gut appears congested and at times slightly cyanotic. The epiploic tags near the perforation are thick, friable and engorged. A fibropurulent membranous exudate frequently covers the gut adjacent to and often over the perforation, thereby obliterating it completely. The mucosa of the involved segment may appear normal or it may be congested and ulcerated. The mesentery is practically always thickened, edematous and hyperemic.

Moure and Desbouis who have made histological studies of this lesion found the spaces between the mucosal glands to contain many polymorphonuclear leucocytes, while the glands which were situated in close proximity to the rim of the perforation showed complete destruction of their epithelial lining which was replaced by red blood cells and leucocytes. The vessel walls were not involved, but the lumina were dilated and filled with blood. The lymphoid follicles were not altered.

Although some investigators have intimated that perforating sigmoiditis is dependent upon dysenteric, luetic or tuberculous ulcerations, a careful review of reported cases fails to indicate symptoms or signs suggestive of these diseases. Patel maintained a frequent relationship between simple ulcerations of the colon and perforations. Quenu and Duval, in their investigations of simple ulcerations of the colon, have found necrosis of the mucosa due to distinct endarteritis of the intestinal vessels, a lesion never found in cases of real sigmoiditis. The role played by fecal stasis in the production of ulcers of the colon has as yet not been definitely established although the consensus of

opinion is that it acts only as a predisposing factor. Bittorf, for example, is of the opinion that fecal stasis may interfere with the nutrition of the intestinal wall, and may therefore be considered a factor in the causation of ulceration.

Patel, however, places the greatest emphasis upon the presence of diverticuli associated with infection. The fact that a diverticulum may not always be demonstrated because of its diminutive size or because it is obliterated by an inflammatory reaction around it does not constitute proof that it may not have been present, since in many of the reported cases a perforation could be readily demonstrated in some part of the diverticulum. This author further argues in favor of the importance of diverticuli as a causative factor in perforations from the statistical analysis of his 28 collected cases of perforated sigmoiditis. Of this number 20 were in men and 8 in women. Ten occurred in persons past seventy years of age, 8 were past sixty, 7 between forty and sixty, and only 3 were in patients between thirty-five and forty. These figures coincide closely with the incidence of diverticuli. Cruvelhier and Zilgien maintain that diverticuli always occur in the aged, usually in persons past fifty years of age. This claim, however, has not been borne out in the cases about to be presented, in which the patients were all younger men. The relative incidence of diverticulosis in men and women in the 1918 cases of the Mayo Clinic series showed that 64 per cent of the patients were men and 36 per cent were women. Inasmuch as constipation is more prevalent amongst women than men it cannot be considered an important factor in the causation of diverticulosis, although it may play an important role in the causation of infection and perforation. It may therefore be stated with relative certainty that a close relationship exists between diverticuli of the sigmoid and perforating sigmoiditis.

Diverticuli of the colon are not of infrequent occurrence. This disease is frequently overlooked because of its tendency, when unaccompanied by inflammation, to show few or no symptoms. Mayo reported in 1929 a series of 1918 cases of diverticulosis at the Clinic and stated that Robertson noted 5 plus per cent in his autopsy material on persons past forty years of age. Of these 1918 cases of diverticulosis, active diverticulitis was present in only 653. Diverticuli are usually multiple and consist of hernial protrusions of the mucosa of the colon through apertures in the muscularis into the mesentery or into the appendices epiploicae. The weakness in the intestinal wall at the site of the hernial protrusion has been attributed to blood vessels which pass through it (Moschowitz).

Why some diverticuli should suddenly perforate into the peritoneal cavity, while others attach themselves to neighboring viscera into which they may penetrate, is difficult to explain. A highly virulent organism may cause rapid disintegration of the attenuated wall of the diverticulum and lead to rupture into the peritoneal cavity before the diverticulum has had an opportunity to approximate itself to some neighboring structure. The inability of the peritoneum in older individuals to readily form adhesions is well known, and may be an important reason why penetrations into the free peritoneal cavity take place. Should such adhesions occur, a localized abscess develops, or what is even more common, a fistulous communication between the colon and the viscus with which it happens to become adherent.

It is not unusual in the more indolent and chronic cases to find the colon thickened and sclerosed with a progressive stenosis of its lumen resulting in varying degrees of obstruction. The exact relationship that this disease bears to carcinoma of the colon is not at all clear. Suffice it to state however that both conditions are frequently encountered in the same patient.

SYMPTOMS

Symptoms of diverticuli of the colon become manifest with the onset of inflam-

mation and vary with the nature of the inflammatory changes and the effects which they produce upon neighboring structures. Practically all cases of diverticulitis present symptoms of spastic colitis with constipation. Recurrent attacks of pain in the abdomen, particularly in the left lower abdomen, distention and constipation constitute an important triad of symptoms. Mucus is practically always present in the stools, while blood may occasionally be found. Fever and chills are present when a perforation occurs in the course of a chronic infection which leads to a localized intraperitoneal or retroperitoneal abscess. When the diverticulum has perforated into an adjoining organ these symptoms will be associated with symptoms referable to the particular organ involved. One may at times feel a mass in the left iliac fossa.

Acute perforations which occur into the free peritoneal cavity may give rise to various types of symptom complexes. In one group of patients there may be a complete absence of symptoms referable to peritoneal reaction, the temperature may only be slightly elevated; yet the patient may be in a state of complete collapse. In another group of patients the only symptom may be a rise in temperature. Other patients show symptoms immediately referable to the abdomen. In the very acute type the symptoms closely simulate those due to ruptured appendicitis and may be so fulminating that the patient succumbs before operation can be performed, as was shown in the case of Mickle.

The acute non-fulminating type which is the more frequent resembles in its onset peritonitis resulting from perforation of a hollow intra-abdominal viscus. The patient appears extremely ill and complains of acute sharp pain in the lower abdomen, generally in the left iliac fossa, although pain around the umbilicus, hypogastrium or even in the right lower quadrant is not unusual. At first the pain is diffuse and becomes localized after several hours. Left lower rectus muscle spasm accompanied by tenderness and lower abdominal distention are signs occurring later in the disease. Dullness in the flanks can frequently be elicited. The temperature usually ranges around 100°F. although it may be considerably higher. The pulse is always rapid. Vomiting is not a prominent symptom. Permitted to go untreated the condition of these patients grows rapidly worse, and death ensues within four or five days.

In the subacute type symptoms referable to peritonitis come on slowly. The patient gives a history of preceding constipation with diffuse dull lower abdominal pain and only slight elevation in temperature.

Lejars reported a series of patients presenting a typical picture of intestinal obstruction. These patients give a history of long-standing intestinal disorders. The symptoms of intestinal obstruction as manifested by drawn facies, abdominal distention, dry tongue, rapid pulse and severe constipation constitute the general picture. As a rule the temperature is not elevated, or only slightly so. At operation or autopsy free pus is found in the peritoneal cavity. It is of interest to note that when the diseased segment of gut is laid open, usually only little obliteration of the lumen is seen.

DIAGNOSIS

The diagnosis of perforating diverticulitis is made with difficulty in most instances. This is especially true in the fulminating cases. It is only when the patient has been completely studied with *x*-rays prior to rupture and the presence of diverticuli established that the diagnosis of ruptured diverticulitis can be made with any degree of certainty. Since ruptured appendicitis is the disease with which perforating diverticulitis is so often confused, it is extremely important to establish a history of a preexisting long-standing constipation accompanied by attacks of left sided abdominal pain as indicative of diverticulitis. Such a history in a patient of middle age coupled with physical signs of an acute surgical abdomen should immediately

arouse attention to the possibility of ruptured diverticulitis. A flat film may reveal the presence of free gas in the peritoneal cavity, thereby indicating the presence of a perforation of a hollow viscus.

TREATMENT

The treatment of perforated diverticulitis is always surgical. Although the seat of the pathological condition, in most cases, cannot be directly attacked at the time of laparotomy, drainage should be instituted in all cases. Many difficulties are encountered in the course of a laparotomy for ruptured diverticulitis. In the first place many of the cases are diagnosed as ruptured appendicitis and a right-sided incision made, making it well nigh impossible to thoroughly explore the sigmoid in the presence of a diffuse peritonitis. Secondly, the inflammatory reaction of the sigmoid is so intense in these cases that the point of perforation can rarely be seen; and even if it is detected, the tissues are so friable that closure is impossible. Finally, the condition of the patient is extremely poor so that any extended procedure is necessarily precluded.

When in doubt as to where to make the laparotomy incision in a given case, it might be well to employ the principle of performing a median subumbilical laparotomy in all cases where peritonitis appears to be due to a lesion in the lower abdomen. When the site of the perforation can be seen and a closing suture can be placed, the opening in the bowel should be closed, and, whenever possible, reinforced with a tab of omentum. The abdomen must always be drained. The remainder of the treatment is the same as that employed in any case of generalized peritonitis. Although operative intervention was instituted in practically all of the cases reported by Patel up to 1911, the patients all succumbed. Of the 4 cases reported by Eggers, 2 recovered, one after laparotomy and drainage, and the other upon whom the diagnosis was not made after expectant treatment.

In cases where a perforation has occurred and leads to a pericolic abscess with localized peritonitis, the appearance of the lesion may so closely simulate carcinoma that the differential diagnosis cannot be made. In this type of case, a temporary colostomy should be performed. After a lapse of several weeks a second laparotomy should be performed to ascertain the nature of the lesion. Should the suspected tumor subside only partially and remain as a chronic induration causing progressive symptoms, carcinoma must be suspected, and appropriate measures taken for its extirpation. Jaboulay as far back as 1897 followed this routine, but with little success. At present the temporary colostomy is employed as an invaluable preliminary to a subsequent colonic resection. Exteriorization of the affected segment was attempted by Moure and Desbouis, but the patient succumbed on the second day after operation. Since then this method has been frequently employed with outstanding success (Eggers, Erdmann, Mayo, Weeder, etc.). Weeks and Brooks reported a successful case treated by simple drainage. Haines reported another case in 1927 and Eggers 2 cases in 1931, one of which was treated by simple drainage, and the other by expectant treatment.

CASE REPORTS

Case 1. E. J. L., male, aged thirty-four, married, a salesman, was first seen December 3, 1929, complaining of abdominal pain and dysuria. The pain was of a dull aching character most severe in the region of the umbilicus, and aggravated during micturition. There was no history of nausea or vomiting, but the patient had suffered from constipation for several years.

Physical examination revealed on obese male, about thirty-four years of age, who appeared acutely ill. Save for diffuse lower abdominal rigidity with rebound tenderness most marked over McBurney's point, the examination was essentially negative. Rectal temperature was 100.4°F. Urinalysis was negative. The preoperative diagnosis was acute ruptured appendicitis.

Operation: December 3, 1929. Under gas and oxygen narcosis a laparotomy was performed through a 3 inch right rectus muscle-splitting incision. When the peritoneal cavity was opened, thick pus escaped. The serosa of the small intestine was markedly injected and the gut distended. Although the appendix appeared thickened and injected, it was obvious that it was not the cause of the peritonitis. Exploration revealed a large indurated mass just above the rectosigmoidal junction. The gut here was of an angry red color, covered by a thick exudate. The epiploic appendages were enormously enlarged, reddened and indurated. After careful search a small perforation was noted in the center of the mass. The appendix was removed. A tab of omentum was laid over the perforation and stitched into place. Two rubber tubes were placed into the pelvis, one large rubber dam laid against the sigmoid, and two small tubes introduced into the lumbar gutter. The wound was closed in layers.

Save for a phlebitis of the left leg the patient made an uneventful convalescence, and was discharged from the hospital January 13, 1930.

Case II. J. M., male, aged forty-one, married, a broker, was first seen in consultation at his home December 30, 1929, complaining of abdominal pain and gastric distention of nine days' duration. The pain began suddenly and was very acute, but was unaccompanied by nausea or vomiting. For three days the pain was constant in the lower abdomen, and was associated with intermittent cramps coming on every ten to twenty minutes. The cramps would begin in the left upper quadrant, radiate across the abdomen and then settle in the right iliac fossa. From the very onset of the pain he complained of gastric distention and constipation. At the age of three he had typhoid, and at nine scarlet fever. Just one month previously he stated that he experienced a similar attack of abdominal cramps lasting five days.

Physical examination revealed a man in the early forties, acutely ill, who was complaining of severe abdominal cramps. The abdominal wall was markedly rigid, especially over the lower part. There was definite and exquisite tenderness. Temperature was 101°F. by rectum. The rest of the examination was essentially negative. The preoperative diagnosis was ruptured appendicitis with peritonitis.

Operation: December 30, 1929. Under gas and ether narcosis a laparotomy was performed through a 4½ inch right lower rectus muscle-splitting incision. When the peritoneum was opened a thin purulent fluid escaped. The appendix was atrophic. Further exploration revealed a large mass situated in the left iliac fossa which consisted of a loop of terminal ileum attached to the lower sigmoid. A large abscess cavity occupied the center of the mass. Upon separating the ileum away from the sigmoid we found that a thick fibropurulent exudative membrane about ¼ inch thick covered the affected segment of ileum and sigmoid. The sigmoid was firmly adherent to the iliac fossa and its wall was markedly thickened and indurated. The epiploic appendages were enormously enlarged, reddened and friable. The perforation could not be detected as a result of the inflammatory exudate which covered the sigmoid. The floor of the abscess cavity was brought into view and a rubber dam and tube passed down to it. A second tube and dam were placed into the pelvis. A third dam was placed under the affected loop of ileum. The wound was closed in layers.

Following the operation the patient appeared extremely toxic. Temperature 104°F., pulse 120. The abdomen was markedly distended. On January 4 he died.

Case III. B. B., male, aged thirty-five, was first seen in consultation at his home on January 9, 1933. He complained of pain in the left side of the abdomen for the past four days. The pain which had been growing progressively worse radiated to the left loin, and was accompanied by chills, fever, vomiting and constipation. For two days prior to this consultation he had urinary frequency and dysuria. For years he had had constipation with recurrent attacks of indigestion.

Physical examination revealed a male individual, about thirty-five years of age, appearing acutely ill, and complaining of severe abdominal pain. His tongue was dry and coated. Temperature 102°F., pulse 120. Abdominal examination revealed diffuse spasticity over the lower abdomen, particularly over the left rectus muscle and left flank. There was positive and exquisite rebound and marked left costovertebral tenderness. Rectal examination revealed an indefinite mass in the left cul-de-sac. The urinalysis showed a faint trace of albumin and an occasional leucocyte.

The patient was sent to the hospital where cystoscopy revealed the absence of pathological

manifestations in the left kidney. With the left kidney definitely ruled out, a diagnosis was made of diverticulitis of the sigmoid with peritonitis.

Operation: That evening under spinal anesthesia (tropococaine) a laparotomy was performed through a 3½ inch paramedian incision. When the peritoneal cavity was opened thick pus escaped. The small intestines were markedly distended and reddened, and several of the loops were covered with fibropurulent exudate. The pelvis was filled with thick pus. The wall of the sigmoid just above the rectosigmoid juncture was found to be partially gangrenous. Owing to the poor condition of the patient and the nature of the affected sigmoid, it was impossible to find the point of perforation. Two tubes and two rubber dams were placed into the pelvis and the wound was closed in layers.

After the operation the patient grew more toxic and succumbed two days later.

SUMMARY AND CONCLUSIONS

1. Diverticulosis is a relatively common condition in apparently healthy individuals. A fairly high percentage of these patients develop inflammatory lesions within the diverticuli which lead to a condition known as diverticulitis. Under certain rare conditions such inflamed diverticuli will rupture into the free peritoneal cavity and lead to generalized peritonitis.

2. A highly virulent organism and impaired ability of the peritoneum to form protective adhesions are the two chief causes for such perforations into the peritoneal cavity.

3. Although most of the reported cases of perforating sigmoiditis with generalized peritonitis occurred in persons past fifty years of age, the 3 cases here reported occurred in younger individuals.

4. This condition should be suspected in a patient presenting signs of peritonitis and a history of long-standing constipation with attacks of pain in the left lower abdomen. This is particularly true in cases of patients past middle life.

5. Every patient known to have diverticulosis should be carefully watched for the early signs of diverticulitis, so that appropriate treatment might be instituted before perforation occurs.

6. Laparotomy with drainage is the only surgical procedure advisable in such cases. The remainder of the treatment is that given to any case of generalized peritonitis.

7. The mortality of ruptured diverticulitis with peritonitis is extremely high.

8. Failure to find the perforation in the sigmoid at the time of operation or at autopsy does not exclude this condition, since in the majority of cases the intensity of the inflammatory reaction of the intestinal wall completely obliterates details of the pathological lesion.

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PRIMARY CARCINOMA OF THE APPENDIX VS. CARCINOID*

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THERE is considerable confusion in the mind of the average surgeon on this subject. He has heard of carcinoid tumor, also of metastasizing carcinoid tumor, and, possibly, even of a true carcinoma of the appendix; but not, as a rule, ever having seen any such cases, he has no definite or clear-cut conception about any of them other than that they might possibly be much alike, perhaps only different stages of the same disease.

Such was the author's misconception, until a recent experience with a case of primary carcinoma of the appendix aroused his interest and caused him to investigate the literature on this subject; with what result? Actually he became more confused than ever, because most past authorities grouped all such cases together and made no distinction between carcinoid tumor and carcinoma. Not only is there confusion in the actual identification or separation of carcinoid tumor from a true carcinoma, but even eminent pathologists differ considerably on the question of whether carcinoid tumors are malignant or not. One of our most prominent pathologists states positively that carcinoid tumors of the appendix are practically always benign,[3] whereas others[5] are equally certain that all carcinoid tumors, be they single or multiple, in the appendix or in the small or large bowel, are potentially malignant because they all invade the surrounding tissues even though such invasion occurs very slowly. They feel that eventually all would metastasize and therefore these authorities definitely classify the carcinoid tumors among the carcinomata.

Besides the author's case only one other case has been recently encountered at our hospital. Both of these cases of primary carcinoma of the appendix were operated upon and I feel that they should both be reported if only because of their extreme rarity, but, in view of the widespread confusion amongst surgeons on this whole subject, it might not be amiss at this time to briefly sketch the story of carcinoid tumor and try to show wherein it is definitely distinguishable from carcinoma, and to bring out the salient facts in outline form.

"Carcinoid" tumors were first so named by Obendorfer (1907) because, though they morphologically resemble basal-celled epithelioma yet clinically they act in the gross like benign growths; metastasis, in Obendorfer's experience, never occurred, and recurrence after operation seldom happened, or at least only locally. Obendorfer is not only responsible for the name "carcinoid" but he also found and described the chromaffin granules and lipoids contained in these carcinoid cells.

In 1912, Saltykow tried to demonstrate that these cells represented aberrant islands of Langerhans of the pancreas, which they resemble. This is one theory of the origin of carcinoid tumors, but later work showed this theory to be in error by demonstrating that the carcinoid cells contain special "silver-reducing granules" which the Langerhans cells do not have.

Beginning in 1914, Masson is primarily responsible for our present conception of the origin and development of carcinoid tumors. He showed that the Kultschitzky cells in the bases of Lieberkühn's glands have silver-reducing granules identical with those found in carcinoid cells and besides he was able to trace directly the structural development of carcinoid tumors from these Kultschitzky cells. Further,

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Masson (1928) found evidence of a chronic inflammation in all of the cases of appendiceal disease having carcinoid tumor, manifested not only microscopically but even grossly by a complete or partial obliteration of the appendiceal lumen. He found, further, definite microscopic evidences of a "neuroma" in 86 per cent of these cases; i.e., a hyperplasia of argentaffin cells (cells with silver-reducing granules) and nonmyelinated nerves. He thus elaborates the theory, now most commonly accepted, that carcinoid tumor arises directly from the Kultschitzky cells in Lieberkühn's crypts as a result of chronic inflammation and passes through the "neuroma" stage prior to actual development of the carcinoid tumor itself. Thus, according to Masson, the carcinoids of the appendix are related to the sympathetic nervous system.

Other theories on the origin of these tumors, viz: that they represent aberrant islands of Langerhans (of the pancreas); that they represent heterotopic intestinal mucosa; that they represent true carcinomata from the epithelium of the gastrointestinal mucosa; that they represent aberrant Brunner's glands (of the duodenum); are no longer held by most authorities. While it is true that the intestinal carcinoids[1] fairly closely resemble pancreatic tissue or Brunner's glands or heterotopic intestinal mucosa, the analogy ends there. There is no definite proof that the carcinoid tumors arise directly from any such anlage. All available proof, on the contrary, confirms Masson's work that carcinoids arise directly from the argentaffin cells (Kultschitzky's) in the Lieberkühn glands. Other authorities accepting Masson's theory are Forbus, Ortynsky, Bonnard, Michot, Ewing and Gaspar.

Carcinoids, single or multiple, are the most frequently found neoplasms of the appendix, and they occur principally in the third decade; whereas true carcinomata (as in the 2 cases reported herewith) occur primarily in the fifth or sixth decade, which is the average age for other gastrointestinal carcinomata. The incidence of carcinoid tumor varies, but its occurrence in 0.46 per cent of all appendices studied is the average figure given by most authorities. Only 6 per cent of these carcinoid cases ever show any clinical signs of malignancy such as extension, metastasis, recurrence after operation, etc. Sixty-seven per cent (Norment) to 73 per cent (Warren and Warren) of all reported cases of carcinoid tumor of the appendix occur in females.

The clinical course is simply that of appendicitis, acute or chronic, although cases without any symptoms also occur. The latter are discovered accidently or only at autopsy. In a series of 96 cases reviewed by McWilliams, 83 per cent had symptoms of appendicitis.

Diagnosis is difficult because symptoms are practically always identical with those of ordinary appendicitis. Léorat feels that pain in the right lower quadrant in the absence of fever and with the tenderness persisting between the attacks, is characteristic of new growths of the appendix. The absence of fever and the presence of tenderness over McBurney's point are common signs; whereas nausea, vomiting, generalized abdominal cramps and rigidity were much less frequently found.

The prognosis is good. These cases run a relatively benign course, clinically. In fact Ewing says that carcinoids of the intestine are frequently malignant in character but "the appendix carcinoids are practically always benign." Metastasis usually does not occur and operation completely relieves the condition except possibly in a very small percentage of cases where a local recurrence may develop.

Pathologically, carcinoid tumors occur singly or in multiples in the mucosa and submucosa, and on section are yellowish or orange in color and firm in consistency. Occasionally they are brownish opaque nodules that have a smooth outline. They occur especially in the distal half (in 92 per cent of cases it was in the distal one-third, Norment) of an appendix, the seat of chronic inflammation. The ap-

pendiceal lumen is almost invariably obliterated in whole or in part but the mucosa over the nodule is smooth and never ulcerated. The average length of such a nodule is 8.1 mm., the average width 5.2 mm. In about 6 per cent of all carcinoid cases (including intestinal carcinoids) involvement of mesenteric and retroperitoneal lymph nodes occurs. According to Léorat (1925) only 2 per cent of the strictly appendiceal carcinoids recur or actually metastasize.

As early as 1924 Masson showed that these carcinoid cells have definite morphological characteristics which distinguish them from the true carcinomata. Microscopically, they are composed of solid strands or cords of argentaffin cells having uniform, deep-staining nuclei with only a few mitotic figures. They are oval or round in shape and have a definite alveolar configuration but never an adenoid (glandular) structure, such as is found with the true carcinomata.

The report of our 2 cases of true primary appendiceal carcinomata follows:

Case 1. J. R., aged seventy-seven, male, white, married, was admitted September 1, and died September 4, 1929.

Present Illness: The chief complaint was no bowel movement for one week, and vomiting for the past four days. He was well until one week ago, the bowels normal until then, but no movement since. He never had any pain. The abdomen is distended but he denies loss of weight. Enemas were unsuccessful. He was hospitalized at once but refused operation for two days. When the blood chemistry and clinical findings became much worse (Sept. 3, 1929) he consented to operation.

Laboratory Findings: Blood chemistry: September 2, 1929, N.P.N. 46; sugar 148; chlorides 460. September 3, 1929, N.P.N. 74; sugar 148; chlorides 390.

X-rays: September 2, 1929, flat film fails to show any evidence of intestinal obstruction.

Preoperative Diagnosis: Intestinal obstruction.

Operation (Dr. Prince): Through a right rectus muscle-splitting incision (exploratory); jejunostomy (through left upper rectus) was done. Exploration in the region of the cecum revealed a hard mass. The intestines were distended and color changes characteristic of obstruction were present. Because of the patient's poor condition a simple jejunostomy was done and the abdomen closed without drainage.

Progress Notes: There was good drainage through the enterostomy tube but the patient became progressively weaker with a rising temperature, pulse and respiratory rate and died on the day following operation.

Autopsy Report: "The appendix is not to be found, but in its exact place there are adhesions between the cecum and the upper loop of the sigmoid. A loop of lower ileum 1 meter from the cecum is also adherent to this region. On cut section there is a tumor which has grown into and perforated through the sigmoid from the site of the appendix causing a stenosis of the sigmoid at this point. The tumor in the sigmoid does not involve the whole circumference, but only two-thirds of it. The perforation admits the index finger and passes into the cecum through the dilated appendiceal opening. The tumor is ulcerated and shows gelatinous, transparent areas. Gelatinous small tumor masses may also be seen on the serous surface near the main tumor mass; however metastases are nowhere found. The perforation in the wall of the sigmoid is funnel-like and shows an oblique course."

Anatomical Findings: "1. Primary gelatinous carcinoma of the appendix with extension and perforation into the sigmoid."

Case II. Hospital No. 95254. R. J. H., aged seventy-four, white male, married, was admitted to the hospital April 13 and died April 26, 1933. He was admitted with a diagnosis of right femoral hernia.

Present Illness: His chief complaint was a mass in right groin past four months, which appears to get larger in the daytime, smaller at night. The mass does not seem to increase in size when having a bowel movement, or when straining in any manner. He was constipated, requiring laxatives; occasionally had nausea and vomiting, and had lost 35 lb. in weight during the past few months.

Physical examination showed an emaciated old man, weak and restless.

Abdominal Examination: The abdomen was tender all over especially in the right lower quadrant. No masses or viscera were felt.

There was a large, soft, semi-fluctuating mass in the femoral region, beneath and lateral to Poupart's ligament. It was the size of a small, flattened-out grapefruit, and felt definitely cystic. It could not be reduced, did not transluminate; no impulse was felt on coughing; no visible or palpable peristalsis was present.

Laboratory Findings: W.B.C. 14,100. Urinalysis was negative except for a trace of albumin. Blood chemistry: N.P.N. 34; chlorides 437.

Surgical Tissue Report: "Several moderate-sized pieces of yellowish tumor tissue and mucoid tissue were received from the operating room. Yellow pieces, formed of cells containing abundant dust-like yellow pigment and arranged in masses, resemble adrenal cells, etc. The small mucoid tissue shows dilated structures filled with abundant mucus. Such a picture may be seen in mucoid cancer of the large intestine, but on account of the small specimen a correct diagnosis cannot be made." (Dr. Gaspar.)

Operative Findings: Through an exploratory incision of the femoral region a walled-off mass containing gelatinous material was found and opened. The tumor cavity extended through the femoral ring and into the peritoneal cavity. The wound was closed with one gauze drain.

Discussion: Femoral hernia, lipoma in the femoral canal and gastrointestinal malignancy with partial intestinal obstruction were considered. We especially advised operation because of the clinical symptoms of partial intestinal obstruction and the preoperative diagnosis was "cystic malignant tumor" in the femoral region, possibly in the gastrointestinal tract. Pott's disease with a cold abscess (psoas abscess) was ruled out by spinal *x*-rays. Intestinal obstruction was not demonstrated in a preoperative flat film of the abdomen.

Progress Notes: The patient is coughing considerably since operation; expectorating purulent sputum; getting weaker. He died April 26, 1933.

Autopsy Report: "Abdomen: The omentum was rolled up and matted together with a gelatinous tumor mass. The intestines were adherent with thin, small, pearl gray tumors in the serosa. The duodenum was adherent to the liver with a hen's egg sized tumor similar in character to that described above. Surrounding the end of the cecum and apparently arising from the base of the appendix which was completely destroyed was a fist-sized tumor mass. This was thick, white, nodular mucoid in character and was adherent to the abdominal wall just above Poupart's ligament and continuous with a similar mass in the right groin. The center of the latter contained a light brown cheesy center present in copious amounts. The liver weighed 1260 gm. and was adherent to the diaphragm which was infiltrated with tumor mass similar to that described. The liver on section was yellow and showed a typical nutmeg appearance. The spleen was adherent to the retroperitoneal structures and surrounding tissues and was infiltrated with the metastatic tumor. It was somewhat larger than normal and on section was flabby. It weighed 210 gm. The kidneys presented a normal appearance, the capsules stripping easily. The right weighed 150 gm., left 170 gm. Adrenals: there was some thickening of the cortex with thinning of the medulla. The pancreas was not remarkable. It weighed 60 gm. The bladder was distended halfway to the umbilicus with clear urine. The wall and mucosa were normal in appearance. The prostate was slightly larger than normal, but was of normal consistency. Posterior to the rectum and infiltrating the wall and mucosa was a flattened hen's egg sized tumor mass extending to within 5 cm. of the lower limit of the rectum. The lumen was somewhat constricted, barely allowing the passage of the index finger. On section, the tumor presented the appearance similar to that described for the other tumors."

"Anatomical Findings: (1) About two-fist-sized primary mucoid adenocarcinoma of the appendiceal region very probably originating from the appendix. (2) Infiltration of the psoas muscle and the right inguinal region. (3) Generalized carcinomatosis: abundant cancerous nodules of the peritoneum, serosa of the intestines, omentum and pleural surfaces. (4) Moderate chronic fibrous endocarditis of the tricuspid valve and moderate arteriosclerosis throughout. (5) Brown atrophy of the heart and moderate anemia. (6) Partial intestinal obstruction of the lowest ileum due to the tumor mass in the vicinity and moderate dilatation of the small intestines. (7) Moderate emphysema and edema of the lungs. Generalized osteoporosis."

"Cause of Death: (1) Large primary mucoid adenocarcinoma of appendiceal region. (2) Generalized carcinomatosis and anemia."

"Tissue Report No. 576. Appendiceal area: primary mucoid carcinoma. Widespread metastasis. Sections taken from heart, lungs, liver,

spleen, kidney, pancreas, adrenal, prostate and the findings correspond with those indicated in anatomical diagnosis." (Gaspar.)

SUMMARY

1. Two rare cases of primary carcinoma of the appendix are reported.

2. The essential characteristics of carcinoid tumor are given to enable the surgeon to more readily understand the differences between these two easily confused tumors.

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HEMANGIO-ENDOTHELIOMA OF OMENTUM*

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PRIMARY tumors of the omentum are uncommon and are usually of the cystic type, which explains the title by which most of them are classified, "cysts of the omentum." Grouping them by their physical characteristics has left much to be desired etiologically. Frank[1] objects to the word "cyst." He states it has no specific meaning except a collection of fluid, but suggests "cystoma," a term that should be applied to a neoplastic formation. It is evident by pathological examination of the few cases reported as cysts, that we are including, in this catagory, collections of fluid in the omentum due to venous or lymphatic stasis, and cystomata with proliferation of cells about the blood or lymphatic vessels and possibly degenerating malignant tumors. A survey of the cases reported soon convinces one of the lack of understanding of the nature of the tumor and how all cystic tumors of the omentum have been tossed into a general classification.

The etiology has provoked a long but interrupted discussion. There are two types of cystomata: (1) lymphatic; (2) hemangiomatous. Grausman and Jaffe[2] in a careful consideration of the literature and an excellent report of one case, conclude that omental cystomata are of lymphatic origin. In their case it was plain that many lymph channels had developed with hypertrophy and hyperplasia of the lining endothelium. Dowd,[3] Ryan[4] and Campbell[5] are among those who believe the lymphatic cysts are congenital defects. The fluid within the cyst wall gives no clue as to the nature of the histology of the cyst wall, as the following description of the fluids in reported cases will illustrate: "black, hemorrhagic," "clear slightly bloody fluid," "greenish brown fluid," "clear rose colored fluid," "dark brown fluid," "congested and infected with blood," "slightly opalescent." Jackson[6] and Lawrence[7] report cases and review the literature.

The case herein reported seems a clear-cut entity from a histological standpoint and it is similar to a few cases of omental cysts reported. In this particular case, not only was an excellent specimen obtained at operation, but subsequently at the second operation similar specimens were secured and were identical with the first in their gross and microscopic morphology. The following case came under our observation:

Miss C., female, aged twenty-three, was admitted to the hospital November 25, 1930 complaining of pain in the right side of the abdomen. Shortly before admission the pain was on the left side of the abdomen and she had vomited.

Past history was unimportant, the patient having had the common contagious diseases in childhood and a tonsillectomy in 1928. Her menstrual history was not noteworthy.

Examination: The patient presented a diffuse tenderness in the lower right abdomen and slight general rigidity. The heart and lungs were essentially negative; temperature 100.2°F.; pulse 130; blood pressure 126/70. R.B.C. 2,980,000, W.B.C. 14,200. Hemoglobin 40 per cent (Dare). Differential count: polymorphonuclears 83 per cent; lymphocytes 13 per cent; monocytes 2 per cent; basophiles 1 per cent; bands 1 per cent; coagulation time 6¾ minutes. Wassermann reaction negative; urine negative. The preoperative diagnosis was acute appendicitis.

Operation: As soon as the abdomen was opened by a right rectus incision, a large quantity of bloody fluid (uncoagulated) was evacuated. A cyst about 10 cm. in diameter was found in the left ovary and was removed without rupture. The appendix appeared normal and was not removed, but further exploration of the abdomen was undertaken. In the upper abdo-

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men a large mass almost globular and quite movable could be felt, a little to the left of the median line. The incision was closed and a

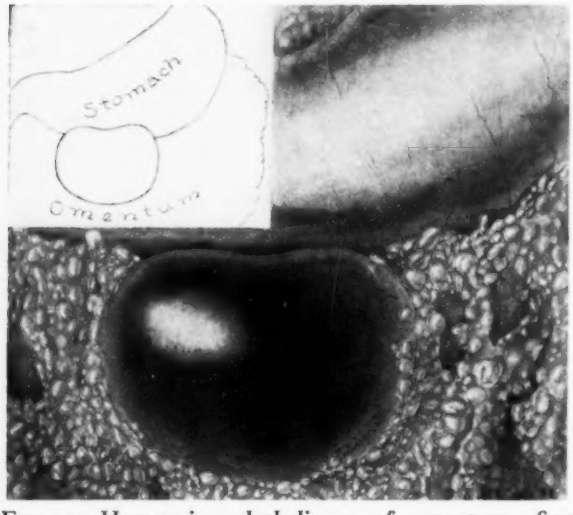

Fig. 1. Hemangio-endothelioma of omentum, first specimen.

second incision was made through the upper part of the left rectus muscle, and exposed what appeared to be a large hematoma between the layers of the great omentum and with its upper border in close contact with the stomach. The tumor was excised, together with a section of the stomach, as we believed at the time that a gastric vessel had ruptured into the omentum, probably from a minute ulcer. The patient's recovery was rather slow and caused us some anxiety.

Microscopical examination of the ovarian tumor showed it to be a dermoid, while the nature of the sanguineous tumor from the omentum was not disclosed at this time. A certain amount of trauma and hemorrhage tended to mask the real pathology.

The patient was seen at intervals for about two months after the operation, when she was able to resume her clerical duties. We were called to visit her September 27, 1932, when she was again admitted to the hospital, or approximately twenty-two months after her first operation.

Second admission to hospital, September 27, 1932: The patient complained of soreness in the left lower quadrant of the abdomen, of six days' duration. It was attended with slight fever but without nausea or vomiting. The pain did not radiate and was described as an ache or soreness. Examination of the abdomen revealed a slight general distention, with a globular mass on the left side just below the level of the umbilicus. The mass was not movable, was dull on percussion, and slightly tender; it suggested a cyst. The two scars indicated that the wounds of the previous operation had healed satisfactorily, without hernias. The general condition of the patient was good. The preoperative diagnosis was an abdominal tumor, probably a cyst, of unknown origin, and incomplete intestinal obstruction.

Operation: September 28, 1932, through a lower left rectus incision, an adherent mass, cystic in character, was found adherent to and partially obstructing a loop of small bowel. As it was delivered, the cyst was found to be an intimate part of the great omentum, and as the omentum was exposed a number of other cysts were found in its structure.

The entire omentum was removed with its numerous cysts and the wound closed without drainage. The postoperative course was not unusual except for the presence of excessive nausea and moderate vomiting in the first week. The patient was discharged from the hospital eighteen days after operation and has remained well since.

Pathological Report No. 48,587 George Washington University: Pathological Diagnosis: Hemangioendothelioma.

Tissue Description: "Grossly: The specimen consists of a portion of the omentum to which is attached various sized soft hemorrhagic appearing cystic structures. The omentum measures 25 cm. long, by 5–10 cm. wide, by 2 cm. in thickness, and contains a generous amount of firm, yellow, adipose tissue. Attached to this are found the cystic tumor structures described above. They vary in diameter from 1 mm. (there are many of this size) to large gelatinous cystic masses which measure 10 cm. long, by 8 cm. wide, by 6 cm. in thickness. Some of these hang in polypoid-like structures from the surface, while others are deeply imbedded in omental structure. Cut section through these masses show them to be somewhat mucoid and gelatinous in consistency, to be surrounded by a very thin serous membrane, and in several instances, irregular groups of cells form yellowish-white opaque structures in the central portion.

"Microscopic examination through the central portion of the cystic masses show them to be surrounded by a thin atrophic fibrous

connective tissue capsule, beneath which are present numerous irregular and conglomerate masses of endothelial cells, which are small,

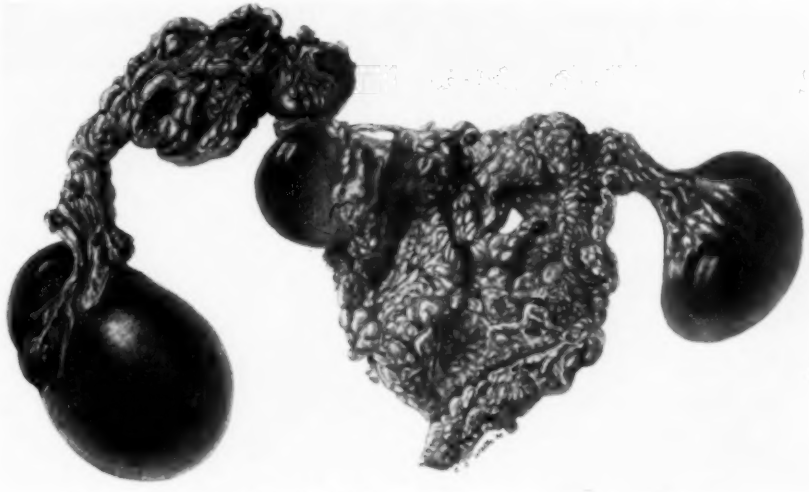

Fig. 2. Hemangio-endothelioma of omentum, later specimens.

cuboidal, round, and oval in shape. Their nuclei are markedly hyperchromatic and in some instances show mitosis. Interspersed through the cell masses are found hundreds of various sized irregular capillary blood channels which are lined with a single layer of endothelial cells similar to those in the surrounding structures. Also a few definite isolated blood vessels with thin atrophic walls are present. Large irregular spaces filled with red blood cells and coagulated fibrin which has a pseudo-mucinous appearance make up the bulk of the tumor.

"These neoplasms are usually slow in growth, but progressive, and while they do not metastasize like a true malignant growth, they have a tendency to recur and with each recurrence are apt to show increasing capacity for growth and changes in cell structure. Ultimate prognosis is unfavorable." Roger M. Choisser, M.D.

After a careful review of the literature one is surprised at the meagerness of the data concerning the histology of omental cysts. There appears very little in recent writings on the subject except that of Grausman and Jaffe (1928)[2] who discuss this feature of their case of lymphangioma at some length. Earlier authors have seemed content to call the growth merely a cyst of the omentum.

It is very apparent that some distinction is necessary and that all cysts cannot be grouped under one head from a gross examination. It would be just as consistent to mention all growths in the breast as tumors of the breast.

Primary cysts of the omentum are probably of two types, the hemangioma and lymphangioma.

Ryan[4] reported a total of 44 cases up to 1926, and several have been published since, but one is unable to learn, after reading the description of the tumor, whether the cysts fall under the head of primary or secondary growths; nor is it possible to identify them pathologically as no pathological report accompanies most of the cases. It is very manifest however, that hemangiomata, or strictly speaking, hemangio-endotheliomata, are exceedingly rare, and very little is known of their etiology and course. We have the word of the pathologist in our case that recurrence is likely or a similar growth elsewhere is probable.

Bold indeed would be the clinician, be he surgeon or internist, who would attempt to formulate signs and symptoms for guidance in the diagnosis of omental cysts of any type. In only two of the reported cases was such a preoperative diagnosis made. The major problem seems to be the proper

treatment when the situation is met, and, of course, after the abdomen is opened. We failed completely, in the case here reported, to grasp the nature of the pathological condition and were fortunate in having a second opportunity to observe and treat this rare condition. The treatment instituted, excision of the entire omentum, may not suffice to give a permanent cure. The second operation could have been eliminated had we been conversant with the gross and minute pathology at the primary operation.

SUMMARY

Less than 50 cases of cysts of the omentum have been reported, and in but two has the preoperative diagnosis been correct.

It has been impossible to classify the tumors because of lack of gross and microscopical investigation. It would seem from the scant literature available that primary cysts of the omentum are very rare and are either lymphomata or hemangio-endotheliomata. There is no available literature on the comparative frequency; we lack reliable symptomatology and will probably never have it; the prognosis is still represented by x, and the surgical treatment has not been written. There is no medical treatment. The aid of a competent pathologist and a biopsy are almost indispensable in the intelligent management of primary cysts of the omentum. Total extirpation of the omentum is recommended as the elective operation.

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PARTIAL INTESTINAL OBSTRUCTION

DUE TO CONGENITAL ANOMALY OF THE DUODENUM, AND PARTIAL ROTATION OF THE COLON

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THE causes of intestinal obstruction, either complete or partial, according to Hartwell and Cooper[1] may be external: such as herniation, volvulus, peritoneal bands, acute peritonitis, neoplasms, ulceration with cicatricial constriction, congenital malposition; or internal: due to intussusception, foreign bodies, neoplasms, congenital diaphragms or bands, thrombosis, embolism, dynamic ileus, or lead poisoning.

In this paper we are interested only in those cases of partial obstruction due to peritoneal bands, external in origin, and congenital malposition. Partial obstruction due to congenital anomalies at the duodenojejunal angle is exceedingly rare. Many cases have been reported of complete obstruction due to congenital occlusion of the duodenum by a complete diaphragm. Calder[2] is credited by Davis and Rynter[3] with having recorded the first case of congenital duodenal occlusion. In 1901 Cordes[4] gathered 57 cases. In 1912 Spriggs[5] reported 92 cases. Cautley[6] in 1919 added 11 cases. From 1919 to 1926 the literature revealed 12 more cases. In 1928 Garvin[7] reported a case in a child four days old.

Seidlin[8] in 1925 collected from the literature all reported cases of congenital intestinal obstruction. From these data he determined that duodenal obstruction occurred in a proportion of a little more than 1:2, and showed that the duodenum has a peculiar predisposition for congenital atresias. Of the reported cases practically all consisted of complete obstruction found soon after birth, and practically all resulted in early death, the condition being determined at necropsy.

Two cases of partial obstruction at the duodenojejunal angle were reported by Judd[9] from the Mayo Clinic in 1929.

In the first case a young man about nineteen years of age had been having vague abdominal symptoms since he was two years of age. A diagnosis of intestinal obstruction of congenital origin was made. When the abdomen was opened a band was found extending across the duodenojejunal angle from the root of the mesentery, being continuous with the posterior leaf of the transverse mesocolon. The mesentery of the small intestine was found to be attached to a limited area anterior to the second lumbar vertebra, being pedunculated at that point. Lateral anastomosis between the duodenum and the loop of the jejunum just below the point of obstruction was made. The patient made an uneventful recovery.

The second case was that of a woman, nineteen years of age, who gave a history of abdominal cramps of several years' duration. Operation revealed constricting bands at the duodenojejunal angle. These were liberated but it was felt that duodenojejunostomy might be necessary later. The ultimate result was found to be only fairly satisfactory.

Freeman[10] reports a case of duodenojejunal obstruction due to bands. In this case the duodenum, instead of appearing in the abdominal cavity in the normal situation, after traveling retroperitoneally, emerged to the right, the transverse and ascending portions possessing a peritoneal covering and a mesentery of their own, similar to the remainder of the small intestine.

The case we report here is very unusual in that three major points stand out in the pathological picture: (1) A band from the transverse mesocolon about 1 inch in width obstructed the distal third of the duodenum at the duodenojejunal angle. (2) The duodenum at this point did not enter the abdominal cavity at the usual site, directly to the left of the spinal column

at the ligament of Treitz, but turned downward and to the right, with the jejunum passing between the folds of the mesentery

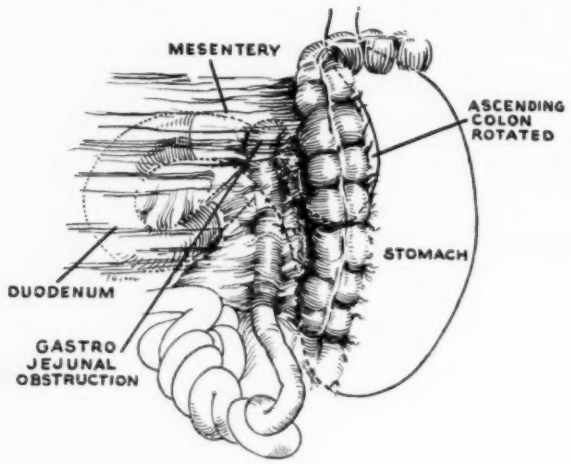

FIG. 1.

of the ascending colon and entering the abdominal cavity in the right lateral gutter distal to the cecum. (3) The cecum and the ascending colon had an abnormally long mesentery so that it could be rotated 180 degrees medially.

In all the cases found in the literature there was no mention of the duodenum and jejunum traveling in such a manner and combining with a second congenital anomaly, partial rotation of the colon, so as to form the afore-described condition.

REPORT OF CASE

A boy, eight years of age, complained of pain in the right lower quadrant of the abdomen, with a second area of pain just above the umbilicus, and vomiting, bile-stained in character. Twenty-four hours previously pain developed in the right lower abdominal quadrant, sharp in character, and much more severe just superior to the umbilicus. It radiated to the right upper quadrant. There was no diarrhea. Temperature was 100°F. He appeared to be acutely ill.

Examination showed moderate tenderness over McBurney's point with definite muscle rigidity. The two upper quadrants of the abdomen were distended, tympanic, and marked peristaltic waves were noted. The boy was emaciated, his cheeks were drawn. He appeared to be about 20 pounds underweight.

History: At the termination of the sixth week of life, which had been normal, he developed an attack of vomiting and rendered loud, piercing cries several times during a twenty-

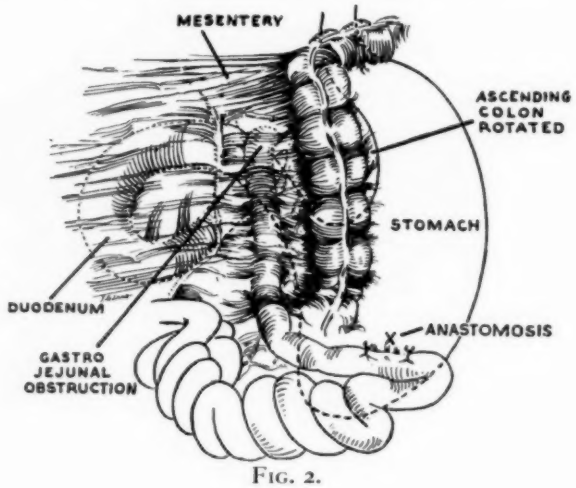

FIG. 2.

four hour period. After three days these subsided. The attacks were repeated for years, occurring two to four times annually. In the beginning, a diagnosis of pylorospasm was made, and later a diagnosis of congenital anomaly of unknown origin. In the summer of 1932 another severe attack lasted two weeks. *X*-rays taken showed the colon close to the midline of the body with no evidence of pylorospasm and the appendix was not visualized. From then until October he was free from pain but was unable to gain weight. It had always been difficult for him to retain solid food and during these attacks only liquids were retained. Diarrhea never occurred and constipation was the rule throughout his entire life. The only other illnesses had been measles and chicken pox.

It was felt, because of the boy's condition, that a laparotomy should be done and the acute appendix removed.

Operation: On October 26, 1932, he was operated upon. A right rectus incision was made and when the abdomen was opened an acutely inflamed appendix was removed. On further investigation the cecum and ascending colon were found attached by a long mesentery to the posterior abdominal wall. The colon could be rotated medially 180 degrees. On further inspection, the jejunum and the ileum were found collapsed, lying in the right lateral gutter. The mesentery to the small bowel was attached for a distance of 3 inches over the first, second and third lumbar vertebrae. The middle and

left portions of the abdomen were free of any intestines. On tracing the jejunum upwards to the duodenum, we found it to enter the folds of the mesentery of the ascending colon on the lateral side, about 2 inches above the cecum. It traveled through the folds of the mesentery to the duodenojejunal junction where there was a marked constriction held down by a band arising in the root of the mesentery which passes into the posterior leaf of the transverse mesocolon. The band was about the size of the middle finger, was very dense, and did not lie along the posterior wall but was raised from it for a distance of about 1 inch so that a finger could be slipped under it.

The condition of the patient was so poor that it was thought inadvisable to do more than relieve the constriction at the duodenojejunal junction. The abdomen was closed and the patient was returned to bed.

Course: For twenty-four hours his condition improved. He retained fluids and seemed to get some benefit from them. The following day, however, he began to vomit large quantities of dark green fluid. Stomach lavage was done every six hours in the hope that the obstruction would relieve itself as it had in previous attacks. Solution of glucose and saline 500 c.c. was given every eight hours. This routine continued for a period of seven days. Any attempt made to prolong the period between lavages caused him pain and active peristaltic waves were noted from the umbilicus upward and outward towards the right upper quadrant. He slowly lost ground and on the tenth day postoperative there was marked tetany of the hands and feet. I felt that this was due to loss of blood calcium as the result of stomach lavages and vomiting. I felt that the boy was in a precarious state and that surgical intervention should be attempted to save his life.

Because of marked anomaly of the intestines it was necessary to find a means of anastomosing around the obstruction. I felt that any anastomosis would cause a constriction of the ascending colon. To determine the exact position of the stomach he was given barium and held upright before the fluoroscope. The stomach was found with the greater curvature at the level of the pubic arch.

Second Operation: Under ethylene gas anesthesia the patient was operated upon. The jejunum was picked up as it left the lateral side of the mesentery of the ascending colon, brought over to the stomach, and an anterior gastroenterostomy was done.

Course: The boy improved immediately and made an uneventful recovery. At the present time, three months after operation, he has gained 28 pounds, is eating a well-balanced diet, and is free from abdominal symptoms.

EMBRYOLOGICAL EXPLANATION

According to McGlaman,[11] early in embryonic life differentiation of the primitive digestive tube begins. At first the foregut and the hindgut are united by an opening in the yolk sac which gradually narrows to form a tubular stalk, the vitelline duct of the umbilicus.

During the fourth week the liver diverticulum appears just above the opening of the yolk sac. Subsequently the future stomach shows itself as a fusiform dilatation of the foregut beyond the liver bag. The interalimentary tube is attached to the dorsal wall by a mesodermal band from which the mesentery is later developed.

By mesodermal tissue the stomach is held at two points in an anteroposterior position, with the greater curvature toward the vertebrae and the lesser toward the anterior body wall.

As the intestinal tube lengthens the postmesodermal band which carries the blood vessels becomes drawn out and thinned, forming the posterior common mesentery.

About the fifth month the more rapidly growing dorsal greater curvature is carried down and to the left and at the same time the organ becomes twisted so that the right surface rotates backward and the left surface forward. With the elongation of the intestine there is coiling of the tube with resultant folding of the mesentery.

The coils of the small intestine fall to the right of the vertebrae while the large bowel is found on the left. Both large and small intestines are attached to the vertebral column by a common mesentery.

The large bowel at this point is carried over in front of the small intestine, the

cecum resting under the liver. Later the cecum descends into the right iliac fossa.

Mesodermal attachments change either in unison with the foregoing changes or following them. The mesenteries of the ascending and descending colons usually disappear.

This is an outline of the normal development. In the case reported the band which partially and later completely obstructed the duodenojejunal angle, as in Judd's case, arose from the root of the mesentery and after passing across the duodenum, became continuous with the posterior leaf of the transverse mesocolon. This band was very dense, about the size of the little finger, and ran obliquely downward from right to left. In it ran a large vessel, probably the superior mesenteric artery. How that band occurred and from what it was definitely derived embryonically has not so far been definitely determined.

In the rotation of the colon from the left to the right, the small intestine with its mesentery, situated in the right middle and right lower quadrants to the right of the vertebral column of the abdomen, prevented complete rotation, the mesentery of the ascending colon remaining long and the duodenum and jejunum passing downward retroperitoneally to the right iliac fossa, instead of to the left. The attachment of the primary gut tube to the right side of the abdomen instead of to the midline seems to be the most plausible explanation for this congenital abnormality, the resulting development being centered in this side with rotation downward and to the right of the duodenum and jejunum and the large proportion of the small intestine with mesenteric attachment in the right, middle and lower abdomen.

CONCLUSIONS

This case is interesting from many angles. The serious question of diagnosis arose without laparotomy. The *x*-ray gave a clue but conclusive only as to the partial rotation of the colon. The upper digestive tract anomaly was never diagnosed although something very abnormal was known to exist. At one time pylorospasm was seriously considered but the bile present in the vomitus eliminated this condition.

The treatment in these cases seems to be surgical without reservation, one of the anastomoses past the obstruction area being the ideal procedure. To loosen up the obstructing band as attempted in this case at the first operation and as done in the second case reported by Judd does not seem to give satisfactory results, in our experience causing more severe symptoms.

When to do the operative work is a problem. In our case the operation was done in a moment of frank desperation when the condition was critical. In case of complete obstruction, no matter how bad the patient may be, it should be done at once. The chances of improvement are remote without operative interference. In cases of partial obstruction, to get the patient in the best possible condition would seem to be the most rational course. As the condition is so rare, with no precedent so far established, each practitioner must fall back on his best judgment.

Following operation the result in this case was very marked and should encourage diligence in recognizing these cases with early operative procedure.

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SUBMUCOUS LIPOMA OF THE TRANSVERSE COLON

COMPLICATED BY INTUSSUSCEPTION AND DIVERTICULOSIS*

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GASTROINTESTINAL lipomata are relatively uncommon. Hiller, in 1899, collected 23 cases. Later Dewis reported 44 cases. Stetten, in 1909, after an exhaustive review of the literature discovered 72 cases. A comprehensive survey of the intestinal lipomata was again made in 1930 by Comfort, who reported 181 cases.

In view of the fact that these lesions are so rare and the literature so scanty, we present the following case:

Mrs. S. S., fifty-five years of age, consulted us on July 27, 1932, complaining of profound weakness and occasional colicky pain over the right upper quadrant of the abdomen. These symptoms had persisted for the past four months. She noted that the pain occurred particularly after eating doughy foods, especially white bread. This was accompanied by nausea and eructation of considerable gas, but no vomiting. She had been constipated throughout her present illness which necessitated the usage of cathartics. There had been no diarrhea or blood in the stools. She complained of anorexia and had lost 20 pounds in weight since the onset of her symptoms.

The *family history and remote personal history* were unimportant, except for the onset of the menopause three years ago.

The *physical examination* in general was negative, except as follows: The upper part of the abdomen was tender and moderately rigid. Over the right upper quadrant in the region of the hepatic flexure a mass was palpable about the size of a large orange. It was firm, somewhat tender and moved on deep inspiration. There was no evidence of any free fluid in the abdomen and no other mass could be palpated. Vaginal and rectal examinations were negative.

The Wassermann reaction and examination of the urine gave negative results. The blood count was essentially normal. Roentgenological examination after the ingestion of barium showed the stomach, small intestine, cecum and ascending colon to be normal. However, there was a definite obstruction of the transverse colon just to the left of the hepatic flexure. A barium enema revealed similar findings.

Considering the age of the patient, the loss of weight, the asthenia, the anorexia and the fact that carcinoma is the most common neoplasm to cause obstruction, we were prompted to make a diagnosis of carcinoma of the transverse colon.

Incidentally the *x*-ray film showed multiple, small, pea-sized diverticula studded throughout the transverse colon, descending colon and sigmoid. These findings were substantiated at operation.

Operation: On August 5, 1932, an upper median incision was made. The liver, gall bladder, pancreas and stomach were normal. A mass was found involving the transverse colon between its middle portion and the hepatic flexure. It was about 9 cm. long and approximately 4 cm. in diameter. It was rather firm, irregular in outline and movable. A temporary appendicostomy was first performed. This was done through a McBurney incision. Her convalescence was uneventful.

On August 12, 1932, one week subsequent to the first operation, the patient was reoperated upon. The original median incision was reopened and much to our surprise we found an intussusception of the transverse colon. The intussusception had slid into the intussuscipiens for a distance of about 12 inches. It apparently was of recent occurrence, as the patient had suffered no symptoms from it and no difficulty was experienced in reducing it. A section of the transverse colon including the tumor mass was resected between Payr's clamps. The excision was done by the actual cautery and an end-to-end anastomosis was performed, employing the Parker-Kerr technique. The patient's recovery from this second operation was likewise uneventful.

* Read before the Clinical-Pathological Conference of Providence Hospital, Detroit, Jan. 10, 1933.

Specimen (Fig. 1): Examination of the specimen removed revealed that a portion of the mucous membrane overlying the tumor had become ulcerated. The growth proved to be a lipoma with a rather broad or sessile base. The site of attachment on the circumference of the bowel was about 90 degrees from the mesocolon. The pathological report was submucous lipoma of the transverse colon.

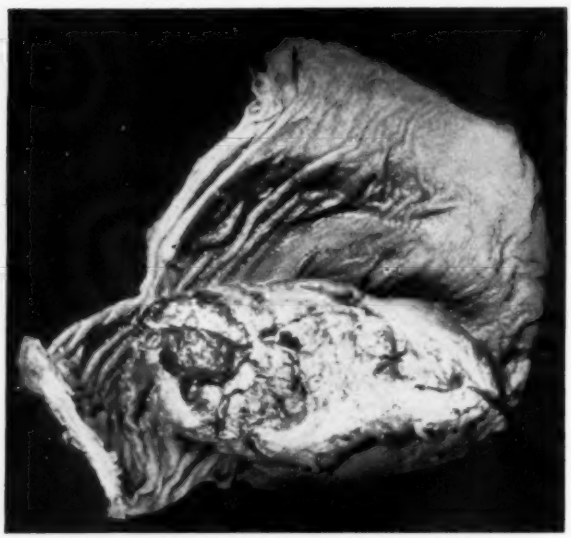

FIG. 1.

Next to adenomatous polyps, lipomata are the most common benign lesions of the gastrointestinal tract. They may develop from the submucous layers and grow inward or from the subserous coat and project outward into the peritoneal cavity. There are cases on record where both types have been found simultaneously. They are usually firm, rounded, lobulated tumors, sharply circumscribed from the surrounding tissue. They have a rich blood supply and present a peculiar structure in that each lobule has a nutrient vessel.

Although benign, these tumors may undergo necrosis, cyst formation, calcification and myxomatous or sarcomatous degeneration. They are found more frequently in the large intestine than in the small intestine. Of the 72 cases reported by Stetten, 41 were in the colon and 31 were in the small intestine. Also, 50 per cent of the patients were between the ages of forty and sixty years, a period of life in which there is a tendency toward adiposity.

It is interesting to note that 50 per cent of the cases reported by Dewis developed intussusception. Comfort, in a series of 91 cases of intestinal lipomata, found intussusception as a complication in 59 cases.

Unfortunately these lesions have no pathognomonic syndrome. Some may go undetected for years and cause no discomfort to the patients. Their most common way of producing symptoms is when bleeding occurs due to ulceration or when obstruction with or without intussusception has developed.

The *x*-ray has occasionally been used in an attempt to distinguish lipomata from other lesions, particularly malignancy, but it has proved unreliable in many instances. Albrecht has suggested that if an apparent benign abdominal tumor is palpable, and the patient is obese, with evidence of lipomata on the body elsewhere, a lipoma of the gastrointestinal tract should be suspected. Bland-Sutton called attention to the finding of a dimple on the serous coat of the bowel during exploration due to the traction exerted by the lipoma.

Nevertheless, it must be admitted that in spite of all the diagnostic means at our disposal, a diagnosis of lipoma is rarely made before operation. A positive diagnosis can only be assured when the tumor mass can be visualized through the proctoscope or when the lesion has prolapsed through the rectum externally.

The treatment is essentially surgical and varies according to the conditions and complications present. The ideal procedure is merely to incise the intestinal wall and enucleate the tumor. However, if the tumor is sessile and firmly adherent and should enucleation thereby jeopardize the lumen of the bowel or leave a deficiency in the blood supply to the intestine, a resection may be necessary with an end-to-end anastomosis. Occasionally a two-stage operation is advisable, performing a preliminary cecostomy or appendicostomy, to be followed later by a resection.

[For References see p. 320.]

IMPALEMENT OF RECTUM*

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RUPTURE of the rectum by impalement is not rare: It is only uncommon. It can be one of the most serious wounds of civil life, especially when the peritoneal cavity has been penetrated. It may result in grave complications and frequently in death.

The first cases reported occurred in agricultural districts. Individuals would jump or slide off of hay stacks, hay mows or loaded hay wagons becoming impaled upon pitch fork handles or similar implements. Rectal injuries have been caused by falls on to stakes, hammer handles, cut-off corn stalks, canes, iron spikes, rifle barrels, legs of chairs, horn of bull and stakes driven into the rectum by criminal or playful intent.

The anatomy and shape of the thighs tend to deflect the foreign body to the interischial space. The ischiae, the pubis, the sacrum and coccyx tend to carry it toward the pelvic outlet. The patient's weight and the distance of fall are also important factors. The foreign body may pass into the rectum with or without injury to the anal orifice. The perineum or the structures lateral to the rectum may be perforated and the rectum entered secondarily. Once inside, the impaling object may be guided by the direction of fall and the bony framework of the pelvis. Very often it becomes impacted against the sacrum or the sacral promontory.

Van Hook, in his collected series, reported that when the peritoneum was penetrated, 71.4 per cent of the patients died. The mortality was nil when the peritoneum was not injured. It is the anterior rectal wall which is usually perforated. This is due to the oblique relation of the rectal canal to the pelvic outlet. The distance of the wound where the impaling object penetrates the rectum into the peritoneal cavity usually varies from 1 to 10 inches from the anus. The average is 2 to 4 inches. Foreign bodies, such as broken-off bark fragments, dirt, clothing, feces and bowel gas may enter the peritoneal cavity. In perforating injuries, with the presence of foreign material, peritonitis usually develops. The peritonitis is usually of the acute suppurative variety and may cause death in thirty-six to forty-eight hours. Cases have been reported where gas bacillus infection and tetanus has taken place.

The amount of shock is usually slight. It is remarkable that often there is very little pain. This has resulted in delay on the part of the patient in seeking proper aid before peritonitis has set in. Hemorrhage from the wound of entrance is usually not extensive. This is likely accounted for by the bluntness of the penetrating object. When bowel gas has been admitted into the abdominal cavity it collects under the diaphragm usually resulting in pain under the rib margins, in the shoulders and back of neck.

The bladder is the most frequently injured organ after the rectum. The posterior wall is injured most frequently, though the fundus, the urethra and the prostate may be damaged. The bladder may have been distended at the time of injury and the opening a large one. The contraction of the emptied bladder may bring the wound edges in a favorable position for healing. Usually the urine escapes with the feces though feces mixed with urine may be discharged by the urethra.

A great variety of other intra-abdominal injuries may take place, such as injury to the pelvic organs, fractures of adjacent

*Read before the Los Angeles Surgical Society, May 12, 1933.

bony structures and injury to the sacral plexus of nerves. The small intestines and mesentery are usually pushed aside. The stomach and liver may be damaged and even the diaphragm has been perforated. However, a detailed history of the injury will lead us to suspect distant injuries.

Examination to determine the extent of injury should be thorough. The question to determine is whether the peritoneal cavity has been entered. When high abdominal symptoms are present the *x*-ray may be of aid in locating a free gas pocket up under the diaphragm. In cases where the peritoneal cavity has been entered, immediate laparotomy should be seriously considered. This should be done with as much promptness as in the case of gunshot wound of the abdomen. Careful inspection, removal of any foreign material, together with proper drainage should be the treatment.

REPORT OF CASE

A school boy, thirteen years of age, in perfect health, who on May 18, 1932, jumped a hedge in his back yard. In doing so his foot caught in the hedge and instead of landing on his feet, he fell striking on top of an upright stake which went through his trousers and up into his anus and rectum. The stake broke off at the ground. The boy pulled out the stake from his rectum himself. The stake was bloody for a distance of 5 inches. He was brought to the Pasadena Hospital at once. He complained of very little pain in the rectum, but had a steady aching pain in the lower abdomen. His pulse was 96, respiration 24, temperature 98°F. There was very little evidence of shock and very little bleeding from the rectum. The impaling stake was one inch square and was wet with blood and serum for a distance of 5 inches. The wet line on the stake was as definite as if it had been dipped into a pail of water.

Under nitrous oxide and oxygen anesthesia an examination was made of the anus and rectum. The anus mucosa was torn for a distance of 2 inches near the posterior raphe. Three to 3½ inches above the anus on the anterior surface of the rectum there was a lacerated tear about 2 inches long extending through the rectal wall. The rectum was empty of feces. A uterine sound was passed without obstruction through this rectal tear for a distance of 5 inches. Our preparation was only for examination and minor repair so the patient was allowed to come out of the anesthetic and was placed in a warm bed. One and one-half hours later the patient was taken to a major operation room, preparation having been made for exploratory laparotomy.

Our plan of attack was based on the following findings:

The wound of entrance, together with anal wound at the posterior raphe gave the direction of the impaling stake. The moisture on the stake indicated that it had penetrated 5 to 6 inches. The organ likely to be damaged was the bladder. The small intestines likely were not damaged. The large blood vessels were not torn as indicated by the limited bleeding. The bladder was catheterized and 150 c.c. of urine were removed. It was smoky, but no blood clots were present. This indicated that the bladder was damaged but it still was able to retain 150 c.c. of urine so we concluded it was not extensively lacerated. A urethral catheter was anchored in situ and continuous bladder drainage instituted. We decided not to do a laparotomy. A large soft Penrose drain was passed through the rectal wound for a distance of 4 inches into the cul-de-sac and anchored by a silk stitch to the edge of the rectal wound. By interrupted silk the rectal wound was repaired about the drain. Another large Penrose drain was passed up the rectum in the direction of the rectosigmoid. The posterior anal wound was repaired by interrupted black silk sutures. A hard rubber tube was placed in the lower rectum to permit the escape of gas.

The patient was returned to bed and placed in the extreme Fowler position. He was put on a peritonitis routine, namely nothing by mouth, 3000 c.c. of normal saline and glucose solution subcutaneously and intravenously daily. Pain and distress in the lower abdomen were controlled by hypodermic injections of codeine sulphate. In other words we began to treat for peritonitis before it developed. His general condition remained very good. For four days the urine contained many blood cells and but few pus cells. At the end of the sixth day, the urine contained many pus cells and but few red cells. The bladder catheter was removed on the seventh day. He had many liquid bowel movements on the seventh and eighth day and

no urine was passed by urethra. The urethral catheter was replaced. The bladder contained 75 c.c. of urine. The frequent liquid stools continued. The following day the boy was given 4 grains of methylene blue by mouth and the liquid stool specimen was sent to the laboratory and tested for urea. Methylene blue color appeared in the liquid stools and 269 mg. of urea were found in 100 c.c. of liquid stool indicating that there was a large amount of urine mixed with the stool. His temperature at this time ranged from 98° to 100°F. Gas and feces were passed by catheter. Boric bladder irrigations and urinary antiseptics were given.

The course was uneventful until the eighteenth day, when he vomited and complained of pain in the left side of the lower abdomen. On the twentieth day he complained of pain in the left kidney area. He had a chill and his temperature reached 102°F. The urine was alkaline and contained many pus cells. On the twenty-second day, his temperature reached 104°F. The diagnosis of pyelitis of the left kidney was made. No instrumentation of the bladder was made at any time. In three days his temperature was normal and remained so. About the thirty-fifth day his stools became well formed and more dry. Up to this time the catheter was left in situ, being changed at intervals. The bladder was irrigated daily, with boric acid solution. The various urinary antiseptics were tried. On the fortieth day the urethral catheter was removed. He started to urinate without any further trouble. The patient left the hospital on the forty-second day. His urine became more clear. Rectal examination showed that the rectal wound was apparently healed and no urinary sinus was found. A cystoscopic examination was made three months later by Dr. Lyle Craig. He reports the following:

"Cystoscopy was done on Saturday, October 1, 1932. The 16 F. Butterfield and 18 F. Buerger cystoscopes were used. There was no obstruction to the urethra and the prostatic urethra and verumontanum appeared normal. The bladder neck was smooth and the trigone and ureteral orifices were normal in position and appearance. Back of the left ureteral orifice was an area on the bladder wall which seemed to show some evidence of scarring, but even this was not well marked. Except for the definite history of injury, it might pass unnoticed.

"Intravenous injection of indigocarmine appeared from the right ureter in three minutes and from the left in three and one-half minutes. In both cases the intensity of the dye was good and the jets were distinct, possibly a little better on the right, but without evidence of obstruction on either side. The ureters were not catheterized. There were no areas of inflammation or ulceration in the bladder and no foreign bodies were present. The mucosa was very smooth throughout. The bladder is evidently entirely healed."

COMMENTS

Injuries to the rectum are always serious. The question to determine is whether the peritoneal cavity has been entered. With the evidence at hand, we were justified in treating our case without laparotomy. However, the abdominal exploratory operation was also justified. When one is uncertain about foreign material such as fragments of wood, clothing or feces, being carried into the abdomen cavity as well as more extensive internal injuries, laparotomy is indicated. When perforation is suspected high up above the line of vision, a laparotomy should be done. Early symptoms should be analyzed and we should not wait until peritonitis symptoms develop. In certain cases a colostomy is even indicated. It is a mistake to close the perforating wound tightly. Free drainage is indicated. Flushing of the rectum and the peritoneal cavity is contraindicated. Antitetanic serum as well as anti-gas bacillus serum should be given.

HEMORRHAGIC MECKEL'S DIVERTICULUM*

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AT the present day it is well known that Meckel's diverticulum exists as a fairly common anomaly, and it may be of interest to those who have not recently had the subject under consideration to appreciate that the presence of a diverticulum has been known since ancient times but that its surgical significance has been generally recognized for scarcely a dozen years.

The first scientific explanation of the fact that it is a remnant of the yolk sac is credited to J. F. Meckel who described its embryology and histology a little over a hundred years ago. Since that time Meckel's diverticulum has more or less constantly appeared in textbooks and surgical literature. While it has been recognized as of great importance surgically when inflamed or adherent it is only within recent years that other conditions involving the diverticulum have received general consideration. Its not infrequent confusion with appendicitis is now well known, and the importance of its differentiation from intussusception, volvulus, intestinal obstruction, ulcer, perforation of an abdominal viscus and even dysentery is now better understood.

Based on an average of routine laparotomies a diverticulum occurs in a little over 1 per cent of all cases and about twice as often in males as in females. The percentage varies, however, as shown by Hall's report of 8133 necropsies at the Dresden City Hospital where congenital diverticula were found 8 times and Green's report of 7.3 per cent true Meckel's diverticula in 150 necropsies. The series of Meckel's diverticulum of Amos Christie at the Babies' Hospital in New York shows an incidence of 1.1 per cent. At Johns Hopkins 2600 post mortems showed an incidence of 1 out of each 173. Mixter concludes that one person in 50 or less harbors a diverticulum, that pathological changes occur more often in the early decades, that the abdomen should never be closed without search being made for a diverticulum in any child in whom the pathological condition found is insufficient to explain the abdominal symptoms and that a diverticulum encountered during an abdominal procedure should be resected unless there is some contraindication. The distance of the diverticulum from the ileocecal valve in infancy is about 12 inches and in adults about 3 feet. It is situated on the antimesenteric border of the ileum and varies in length from a very small elevation to, as was reported in one case, a tubal length of 36 inches. It may persist in its congenital patency with the navel and constitute a fecal fistula and a source of umbilical bleeding in cases where the proximal end of the yolk sac failed to become obliterated. My particular interest at this time is not so much with diverticulitis in general, concerning which much has been written, but rather with intestinal hemorrhage from Meckel's diverticulum, concerning which comparatively few cases are recorded.

With the exception of Hudson and Koplik's series of 32 cases of Meckel's diverticulum from the Children's Hospital in Boston,[15] Amos Christie's "Pathological Study of Meckel's Diverticulum"[5] of 63 cases, R. H. Miller's series of 22 cases from the Massachusetts General Hospital, Charles G. Mixter's analysis of 76 records of Meckel's diverticulum cases in Boston including those of his own, and a few other short series of reported cases by various surgeons, most of the contributions to the literature of Meckel's diverticulitis with

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or without hemorrhage have been made in the journals as single isolated case reports. Discussions of various papers submitted in recent years have likewise usually included a single case report of some recognized surgeon. Among the most interesting of these is the case of Dr. Stone of Richmond, Virginia, in a child of fourteen months with hemorrhage from the navel which proved to be due to an unobliterated persisting congenital yolk sac which was bleeding from the margin of the neck of the diverticulum at its junction with the ileum. Another of these single case reports is that of Reginald Jackson of Madison, Wisconsin, reported in 1924.[16] It was that of a boy age ten, with repeated hemorrhages from the rectum over a period of three years. Various diagnoses were made, including different blood dyscrasias. This boy was relieved surgically by the removal of a Meckel's diverticulum revealing an ulcer at its intestinal margin.

Hudson and Koplik's 32 cases showed the incidence of the presence of gastric mucosa in about 50 per cent. In about 50 per cent also of their cases there was bleeding from the rectum. From a review of this series it was impossible to establish definitely the fact that those cases having gastric mucosa were the identical ones that bled by rectum because a number of the pathological reports were incomplete, a number of the specimens were too ill-preserved to establish satisfactory findings and a number of reports were absent. However, those cases having good pathological reports showing gastric mucosa present were also reported as having bleeding by rectum, and all bleeding cases having pathological reports in this series showed the presence of gastric mucosa. Conversely in the pathological reports of non-bleeding cases the diverticulum was lined by mucosa from either the small or the large intestine, and in one case pancreatic tissue was found. In spite of these facts the authors conclude for some reason that their high percentage of bleeding cases does not necessarily indicate that ulceration was the cause of the bleeding for the reason that the ulcers they saw were not the usual peptic type. Abt and Strauss[1] reported 3 cases of hemorrhagic diverticulitis in 1926 illustrating that ulceration was usually the origin of the hemorrhage. Greenwald and Steiner's series,[11] reported in 1931, showed three distinct types: ulceration with or without hemorrhage; acute diverticulitis; and intestinal obstruction. Peterman and Seeger's[22] case of a boy, aged six, reported in 1928, well illustrates the difficulties of diagnosis of hemorrhage. This boy was trampled upon by a cow seven months before hospital admission, and was struck in the abdomen by a wagon tongue one month before entering the hospital. He presented a hematoma of the scrotum, had considerable abdominal pain, a high white count and was very pale. A diagnosis of appendicitis seemed most probable. When the abdomen was opened free blood was found in the cavity which proved to have its source at the neck of the diverticulum which had been detached from the ileum. His previous tarry stool had been attributed to either his abdominal injuries or a severe grippe which he had recently had.

In the Evanston Hospital we have on record 2 cases of hemorrhagic diverticulitis, as follows:

Case 1. H. T., Jr., aged two, admitted February 2, 1932, with marked pallor apparently the result of hemorrhage from the rectum followed by tarry stools. The child had been in excellent health up to the night before admission when he passed a large quantity of blood by rectum followed soon after by additional bleeding. He was admitted at once in shock, given 50 c.c. of paternal blood intramuscularly, fibrogen by mouth and hypodermically, and liver extract per orem. His blood showed hemoglobin 36 per cent and red cells 2,320,000. The urine was normal. The abdomen showed no rigidity nor tenderness. A gastrointestinal series showed some widening in the terminal ileum which, in the opinion of the roentgenologist, might confirm involvement of the appendix or a Meckel's diverticu-

lum if clinically suspected. The child remained in the hospital eleven days, was given fibrogen again on the sixth day, had no evidence of fresh bleeding after the initial hemorrhage and was discharged with hemoglobin of 44 per cent and red cells 2,590,000. The attending physician in this case, Dr. C. A. Aldrich, reports it as his understanding that a Meckel's diverticulum was removed shortly afterward in a Chicago hospital.

Case II. J. T. B., aged eight, was admitted January 21, 1933, with a history of normal health up to thirty hours before when he complained of nausea, had two small stools showing evidence of blood, felt faint and looked pale. When seen by Dr. Robert Blessing, his abdomen was soft, not tender, and there was no fever. The day of hospital admission he was restless at home, was content to lie down a good deal, complained of being uncomfortable but had no definite abdominal pain. He vomited twice and was given an enema at home which produced a bloody stool followed by two voluntary hemorrhagic movements. I saw him at his home that evening with Dr. Blessing who was suspicious of a bleeding Meckel's diverticulum, and 15 units of thromboplastin were given at once. At the hospital he showed very marked pallor, pulse 132, respiration 30, air hunger, hands and feet cold and damp, hemoglobin 45 per cent, red cells 2,100,000, urine normal. The mother's blood was group II and incompatible, the patient's group IV and the father's group IV and compatible. The patient was seen at the hospital by Dr. Joseph Brennemann who concurred in the diagnosis and the decision to explore the abdomen.

Owing to the apparently extensive hemorrhage a transfusion of a rather large amount (800 c.c.) of the father's blood, which might ordinarily be an overload for a child of his age, was begun preoperatively on the table and continued while the operation was in progress by the resident, Dr. Walsh. When the abdomen was opened there was found a markedly distended urinary bladder at a high enough level to interfere with the examination of the abdominal contents. No free fluid, blood or intestinal content was present in the abdomen and no sign of peritonitis was seen. The cecum and the ascending colon were bluish and apparently occupied with blood. A bluish color with less distention was found in the terminal ileum for about 24 to 30 inches from the cecum. This bluish color extended like the mercury column of a thermometer as far as the point mentioned where a diverticulum about 2 inches long was found. It was thickened, a little bit leathery in feeling, with injected vessels on its surface. Beyond this point the bluish color of the intestine was replaced by a normal pink color and the intestine was collapsed and empty, suggesting that the source of bleeding was within or at the level of the diverticulum or below it, but not at a higher level.

The operative procedure was as follows: As soon as the indirect blood transfusion was going well on the table a median abdominal incision was made from the navel to the pubis. The skin and subcutaneous fat showed very little bleeding and were pale and blanched in color, as were the tissues beneath. When the peritoneum was opened the bluish color of the cecum and ascending colon was easily seen. While the distended bladder was held out of the way, the cecum was lifted up and the appendix located. This was found to be elongated, with considerable injection of its vessels. The ileocecal valve was lifted up into view and the ileum traced as far as the diverticulum above described beyond which the bluish color discontinued. The diverticulum was clamped in the axis of the ileum and reclamped beneath for suture transversely to the axis to avoid narrowing of the lumen. Two rows of sutures were made through the mucosa, and the serosa respectively, so as to peritonealize the latter. A small closed vessel, apparently located in the neck of the diverticulum, was found, and seemed to explain the source of hemorrhage. Stripping from the ileocecal valve to the diverticulum failed to demonstrate the presence of any lesion which might be suspected as a present or past origin of bleeding. The appendix, which during the operation had carried a clamp on its base as a landmark for search of the diverticulum, was removed by ligature at the site of the clamp, its stump buried under a purse string after cauterization with carbolic and alcohol, and the mesocolon ligated. The abdominal layers were closed without drainage.

This patient was in the hospital thirteen days and was discharged with hemoglobin 65 per cent, red cells 3,600,000 and white cells 12,200. His postoperative course was somewhat stormy, with rectal temperature 102°F. the first two days and becoming gradually lower until the fifth day when he had a chill followed

by fever of 104°F., pain in the right hip, vomiting, coughing and some indefinite abdominal distress suggesting a possible obstruction, a leakage at the site of the suture line of the amputated diverticulum or the appendix stump, a septic embolus, a mesenteric thrombosis or a possible pneumonia. There was no evidence of additional rectal bleeding, but slight abdominal tenderness was complained of on both sides. The wound was very satisfactory. In the absence of definite chest findings Dr. Blessing suggested a small pulmonary embolism or a late transfusion or thromboplastin reaction as causes for his symptoms which included a white blood count of 20,000. During succeeding days, however, the convalescence was rapid and he left the hospital in good condition. The pathological report in this case, given by Dr. F. D. Gunn, is as follows:

"Gross: A. An appendix measuring 10 cm. in length and up to 9 mm. in diameter. The serosa is smooth. The serosal vessels are slightly injected. The lumen contains a small amount of greenish stained fresh blood.

"B. A cup-shaped mass of tissue weighing 7 gm. measuring 3 cm. in maximum diameter and about 2.7 cm. from base to apex. One side is covered by a smooth serous membrane raised in thick folds resembling rugae of the gastric mucosa. Near the section margin there is a small hemorrhagic spot consisting of numerous closely set petechial hemorrhages with a maximum diameter of 15 mm. A few similar spots are scattered over the surface elsewhere.

"Microscopic: Sections from different parts of the specimen show a mucosa resembling that of the fundic part of the stomach. The glands are long, slender and branching. Eosinophilic epithelial cells corresponding morphologically to parietal cells form part of the epithelial tubules and in several places are quite numerous. The fibrous stroma is infiltrated practically everywhere with lymphoid cells, large mononuclear cells and eosinophiles. Alternating with the gastric type of mucosa there are patches of practically normal enteric mucosa with villi. The surface of the mucosa is superficially eroded in many places, exposing capillary blood vessels and near the surface there are innumerable small extravasations of blood in the stroma. At one point there is a small ulcer with base and margins formed of necrotic tissue, fibrin, and leucocytes. Just beneath its base there is a collapsed arteriole, but actual exposure or rupture of the vessel cannot be demonstrated in the sections examined.

"Diagnosis: Aberrant gastric mucosa lining a Meckel's diverticulum. Numerous hemorrhagic erosions of the mucosal surface."

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MULTIPLE INTESTINAL OBSTRUCTION*

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OBSTRUCTIONS at one or another point in the gastrointestinal tract are by no means rare and, in fact, constitute one of the most common problems met by those engaged in doing major surgery. In most instances, however, when the point of stoppage or narrowing is found, and that area is properly treated, there is no further cause for concern. New growths of the intestines, whether intrinsic or extrinsic, ordinarily affect but one locality, but when conditions are such that several portions are involved unusual features present themselves. It is for this reason that I venture to present a case history which contains some decidely unique features:

The patient was a married woman, aged sixty years, who had always been healthy and possessed a grown family. About one year previous to entering the hospital she began slowly to lose weight and strength. At that time she was greatly distressed by varicose veins in both limbs and these were treated and obliterated by injections administered by her physician. Save for the slow loss of weight, she remained fairly well until about four months before death. At that time she suffered vague abdominal pains and her habitual constipation became more marked. Being of a temperament which rendered it difficult for her to accept medical counsel, she disregarded the advice of several physicians whom she consulted. Two months before entering St. Vincent's Hospital she was given a thorough examination and an obstruction was discovered about 3 inches up the rectum. At that time she was suffering from abdominal distention, nausea and severe cramps which were localized in the left lower quadrant. An attempt to introduce barium in the colon by rectum failed, but barium by mouth showed a pronounced obstruction in the rectosigmoid. Proctoscopic examination by a specialist in rectal disease confirmed the findings. Fearing operation and a colostomy, the patient disregarded the warnings of her family and medical consultants, and postponed going to the hospital until persistent vomiting had ensued. During the last week the patient was unable to retain food by mouth, and on the day prior to operation the vomitus was distinctly fecal in character. By this time her weight had dropped from 190 to approximately 130, but the heart action, blood pressure, kidney function and blood count remained favorable. As a last resort an exploratory laparotomy was performed with the idea of doing a colostomy and prolonging the patient's life.

Operation: The abdomen was opened through a 5 inch incision in the middle of the left rectus muscle, extending from the umbilicus downward, the lower end of the incision curving toward the midline in order to avoid some very large varicose veins which appeared in the abdominal wall. Despite this precaution several of these veins were cut and being the size of a lead pencil they caused considerable bleeding and annoyance. When the peritoneal cavity was opened some free fluid was present, serous in nature. The small and large bowel were somewhat pale but otherwise appeared essentially normal. The liver was small and very rough over its entire surface, the left lobe being rather more so than the right. This probably was cirrhosis rather than metastasis. The pancreas was small, hard, firm and slightly nodular. Both kidneys were palpated and appeared normal, as did the spleen. There was considerable fat in the abdomen, mesocolon and the omentum. These latter organs were studded with small granules which might possibly be malignant in nature; likewise, the mesocolon contained a number of small nodules. One or two of these nodules were taken out and submitted to Dr. Budd, the pathologist, who was present. Rapid staining revealed no malignancy in any specimen removed. At the junction of the ileum and cecum there were several enlarged lymph nodes, the nature of which we were unable to determine. The growth itself was an annular carcinoma of the rectum,

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extending from about 5 cm. above the utero-cervical junction downward. It was very hard, firm and apparently about 12 cm. long and had the diameter of a normal rectosigmoid. Adhesions between the growth and the posterior surface of the uterus were present and this may have been a direct extension, but since the mesentery of the sigmoid and descending colon was very short, visualization of the growth was impossible, we had to rely solely on palpation. This procedure was made easier by the pathologist inserting his finger in the rectum. In view of the location of the growth and the impossibility of resection, it was decided to do a left-sided colostomy, through a stab wound to the left rectus muscle. The mesentery of the bowel was extremely short and there being great tension on both sides of the loop, a tube of suture material was inserted through the mesentery to keep the bowel outside of the abdomen. A large soft rubber catheter was placed in the upper loop and anchored by dermal suture.

Fig. 1. Section through wall of stomach at pyloric end. Various layers of wall are not seriously interrupted, but scattered nests of cells can be seen through submucosa and muscularis extending to serosa. This type of structure seems consistent with that of diffuse, scirrhous carcinoma of stomach.

The patient rallied somewhat from the operation, but despite supportive treatment such as glucose, salt solution, etc. she gradually became weaker and died on the sixth day.

The *post-mortem examination* showed a large obstructive growth at the rectum, and smaller ones at the ileocecal junction and the pylorus. The details of the autopsy performed by Dr. J. W. Budd were as follows:

The stomach was markedly distended, but the intestinal canal otherwise was not dilated. Opaque white plaques were present in many locations over the peritoneal surfaces involving in particular the serosa of the pyloric end of the stomach, the serosa of the small intestine and its mesentery and the tissues of the posterior surface of the uterus, cul-de-sac, and rectal wall. In the latter location dense fibrous adhesions were prominent. Obstruction of the hollow viscera had resulted from the contraction of scar tissue and a high grade of stenosis with a rigid tube-like wall was found in the pylorus, terminal ileum

and rectum. The mucosa over such areas was found intact however and gross inspection of the lesions revealed only a thickened and scarred wall, the general architecture remaining intact.

Additional findings in the abdomen were: cirrhosis of the liver, chronic cholecystitis with cholelithiasis, and moderate bilateral hydronephrosis.

Microscopical examination of the fibrous plaques and the bowel wall at the sites of stenosis revealed neoplastic epithelial tissue in all of the locations. In the stomach involvement was chiefly of the submucosa with extension and diffuse invasion of the muscularis and serosa. Small isolated collections of atrophic and sclerosed neoplastic cells separated by dense bundles of collagenous fibers were the rule. Infiltration of the serosa and muscularis of the ileum, appendix and rectum by a similar process was revealed. In occasional areas the tumor cells growing in lymphatics were found to be of larger size and gave more evidence of activity, but the large amount of stroma proliferation through out was striking. Metastatic lesions in other organs were not found.

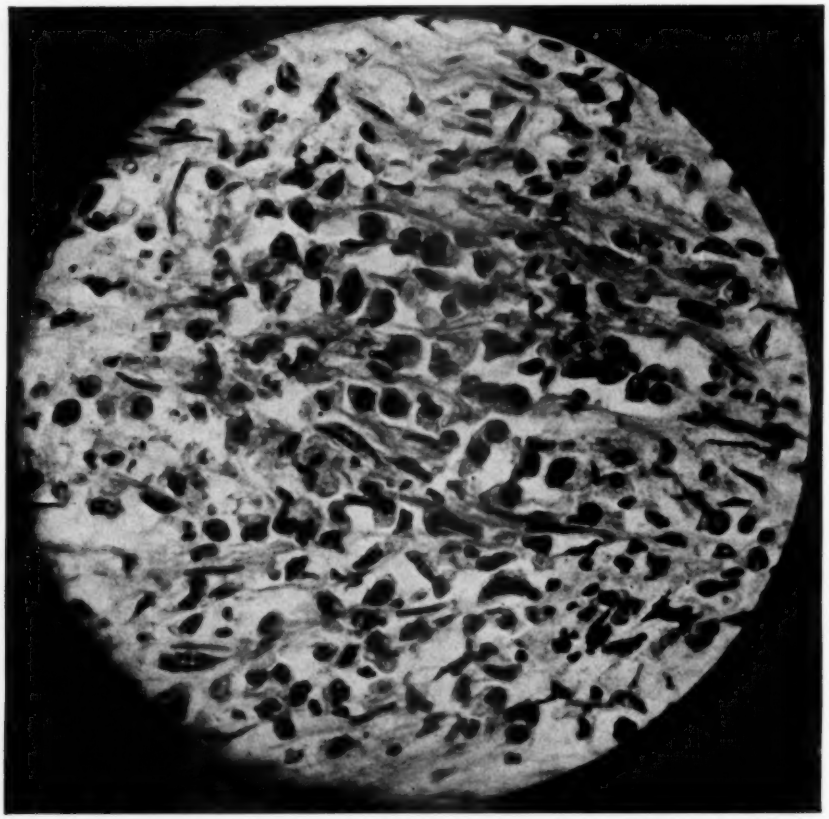

FIG. 2. High power photomicrograph of cancer cells infiltrating muscularis of stomach. Similar type of growth is seen in ileum and rectum. Cells are small and although they line up along connective tissue spaces they do not form acini. Two mitoses are present in center of illustration.

Microscopic Diagnosis: Multiple areas of scirrhous carcinoma of the gastrointestinal tract and peritoneum. Interpretation: It seems likely that the malignant lesion in the stomach is the primary site of the neoplasm; that invasion through the serosa has resulted in a peritoneal dissemination of tumor, with implantations chiefly in the dependent portions.

This neoplasm is of interest, first, in that at no point was a definite tumor (mass) demonstrable grossly since the involvement was a diffuse infiltration without interruption of the general architecture of the organs, and secondly in the location of metastasis, the regional lymph nodes and liver being missed while peritoneal dissemination involved the cul-de-sac and rectal wall producing the initial clinical symptoms.

FATAL HEMORRHAGE IN PEPTIC ULCER TREATED CONSERVATIVELY

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MASSIVE hemorrhage in peptic ulcer constitutes a very difficult condition to treat and it would seem worthwhile to summarize nine deaths from hemorrhage that have occurred in patients under conservative treatment. These cases have occurred on the Fourth Medical and Surgical Divisions* of Bellevue Hospital during the past twenty-two years. It is worth noting that during this period, or from January 1, 1911 to April 1, 1933, we have had 80 cases of severe hemorrhage from peptic ulcer. It includes only those cases that have had one or more hemorrhages which confined the patients to bed and usually incapacitated them for weeks or months. The cases of mild hemorrhage not requiring transfusions, or complete rest, are not included. The 9 cases that are reported have either had a positive diagnosis made by roentgenological study or autopsy findings. There have been a number of deaths from hemorrhage in the gastrointestinal tract which we are not including and these included ruptured esophageal varices, Meckel's diverticula and other lesions bearing no relationship to ulcers.

CASE I. Male, aged sixty years, admitted July 8, 1911, died July 12, 1911. The patient gave a history of moderately severe pain in the epigastrium for nine months before admission, with vomiting of blood and blood in the stools for three days before entering the hospital. There had been no previous treatment and the pain had not been severe enough for him to seek medical treatment. Roentgenological study had not been done but an autopsy revealed a duodenal ulcer in the posterior portion of the duodenum which was penetrating into the pancreas. Treatment consisted of infusions and hypodermoclysis.

Remarks. This patient was in marked shock but a transfusion was not performed, for at the time of admission blood transfusions were not commonly done. From the notes on the record it appeared that his condition was extreme and an operation was not thought advisable.

CASE II. Male, aged forty-three, admitted December 14, 1925, died December 18, 1925. The patient gave a history of having been operated upon for a perforated ulcer in November, 1922. Following this operation he was symptom free until about six months before admission. The pain was getting more severe and he was admitted to the hospital on account of pain and feeling weak. Immediately after being admitted to the hospital the patient began vomiting a large quantity of blood and was given infusions and morphine but he continued to vomit blood and pass tarry stools. On December 16 transfusion of 500 c.c. of whole blood was carried out and his condition improved but on December 18 he had another severe hemorrhage from which he died three hours later. Autopsy revealed a duodenal ulcer just distal to the pylorus with a patent vessel in the crater of ulcer.

Remarks. This patient was showing satisfactory improvement from conservative treatment until he had the severe hemorrhage on the day of his death.

CASE III. Male aged thirty-five years, admitted March 11, 1927, died March 15, 1927. The patient was admitted for pain in the abdomen of a few months' duration, and vomiting for nine days. Before admission the pain was getting gradually worse which necessitated his seeking admission. He had never vomited blood or passed dark stools. A roentgenological study of the stomach and duodenum was done and reported negative on March 14. The same night he had a profuse hemorrhage at 2 A.M. and died within two hours. Autopsy revealed a large duodenal ulcer on the posterior portion of the duodenum, penetrating into the pancreas.

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Remarks: It is interesting to note that this patient had a negative roentgenological study of the intestinal tract and had never had a hemorrhage until two hours before his death, and in spite of supportive measures the hemorrhage proved fatal and a transfusion could not have been given.

Case iv. Female, aged fifty-one years, admitted March 23, 1927, died six hours later March 23, 1927. The patient was admitted with a history of having vomited blood for twelve hours before admission. Previous to that she had no symptoms referable to an ulcer. Infusions, morphine and supportive measures were administered but the patient continued to vomit blood. She was without funds and while arrangements were being made to have a transfusion, as a charity case, she had another profuse hemorrhage from which she died. Autopsy revealed an ulcer in the first portion of the duodenum just distal to the pylorus, with an open vessel in the base of the ulcer.

Remarks: This patient gave a negative ulcer history and the first symptom she had was a hemorrhage which took place twelve hours before admission, and in spite of supportive treatment after admission she died six hours later.

Case v. Male, aged forty-four years, admitted August 8, 1927, died August 10, 1927. The patient was admitted with a history of having vomited blood six hours before entering the hospital. Previous to that he had no symptoms referable to an ulcer. A transfusion was given on the day of admission with 500 c.c. of blood by the direct method. Transfusion was again carried out on August 9, with 500 c.c. of blood, after which he appeared in good general condition and stopped bleeding but the next day, August 10, he had a rather severe hemorrhage from which he died three hours later. Autopsy revealed a gastric ulcer on the lesser curvature of the stomach in the region of pars media and pylorica with a patent vessel in the base of the ulcer.

Case vi. Male, aged fifty-six years, admitted August 20, 1929, died August 23, 1929. The patient gave a history of bleeding from the rectum seven days before admission and on the day of admission he felt weak and passed several dark stools. He was given an infusion and the next day, August 21, he was given a transfusion of 500 c.c. of blood by the direct method. The patient had not bled since entering the hospital but twelve hours after the last transfusion he had a severe hemorrhage, vomited blood, went into shock and died two hours later. Autopsy revealed a gastric ulcer on the lesser curvature in the prepyloric zone with a large vessel at its base.

Remarks: This patient was progressing very satisfactorily until he had the sudden hemorrhage which proved fatal.

Case vii. Male, aged forty-four years, admitted November 17, 1930, died November 20, 1930. On admission the patient complained of being weak, vomiting blood and passing dark stools for twenty-four hours. Previous to that he had no symptoms referable to an ulcer. After admission to the hospital there was no evidence of hemorrhage. Patient's general condition was good, fluids were restricted by mouth, he was given morphine and his general condition continued satisfactory for the next three days but on November 20, at 3 a.m. he had a profuse hemorrhage and died twenty minutes later. Autopsy revealed an ulcer in the first portion of the duodenum, 1 cm. in diameter, on the posterior wall which was penetrating into the head of the pancreas.

Remarks: It is worth noting that this patient had a negative history until twenty-four hours before admission and after admission to the hospital his general condition was good, and there was no evidence of bleeding and no apparent need of a transfusion but after being in the hospital for three days with rest, restricted fluids by mouth, and morphine, he had a profuse hemorrhage from which he immediately died.

Case viii. Male, forty-eight years of age, admitted January 7, 1931, died January 8, 1931. Twenty-four hours before admission to the hospital he did not feel well and vomited blood. He continued at work that day but after going home at night he vomited blood and passed dark stools. A private physician was called and he was advised to rest, was given a sedative and was to call at the physician's office the next day for *x*-rays. The next morning, January 7, he vomited a large quantity of blood and was brought to the hospital in extreme shock. He was immediately given 500 c.c. of blood, by the direct method, followed by infusions, but his condition remained critical and he died at 4.30 a.m. on January 8, or fifteen hours after entering the hospital.

Remarks: It is interesting to note that this patient had a negative gastric history until twenty-four hours before entering the hospital when he began bleeding.

Case IX. Male, aged thirty-six years, admitted January 27, 1933, died February 22, 1933. The patient was admitted to the medical service with a history of having had pain in the epigastrium and vomiting for nine days previous to entering the hospital. He was under observation in the medical ward for twenty-four hours when he had a sudden sharp pain in the abdomen and went into shock. A diagnosis of perforated ulcer was made. On January 28, the patient was operated upon for a perforated ulcer and the laparotomy revealed a perforated ulcer on the anterior wall of the stomach, near the pylorus. This was closed with two layers of chromic gut and the patient made an uneventful convalescence from the operation, with the exception of a slight wound infection. On February 18, the patient vomited a large quantity of blood, passed dark stools, and was in extreme shock. Transfusion was performed a few hours later with 500 c.c. of blood, by the direct method, and he was given an intravenous saline infusion. He continued in marked shock and transfusion was again done on February 19, with 500 c.c. of blood, and again on February 20 he was given 500 c.c. of blood, but the bleeding continued and he died February 22 from lobar pneumonia. Autopsy revealed a 3 cm. incision on the pyloric end of the stomach which was healed and covered with omentum. When the stomach was opened a large butterfly ulcer 6 cm. by 3 cm. was present on the lesser curvature in the prepyloric region directly underlying the incision mentioned. On the wing of the ulcer, which lies on the anterior stomach wall, is seen a small vessel, the lumen of which is about the size of the lead in a large lead pencil. The lumen is open and has apparently been the source of the gastric hemorrhage. Another ulcer 2.5 by 2 cm. lies on the lesser curvature directly below the esophageal opening into the stomach. There was no evidence of bleeding from this ulcer.

Remarks: This case is interesting because he had made an uneventful convalescence from the perforated ulcer, except for the slight infection of the wound, and would have been discharged from the hospital before the hemorrhage occurred if it had not been for the infection.

In reviewing the foregoing cases there are several interesting observations. Of the 9 cases presented, 5 were negative for any ulcer symptomatology until the onset of the hemorrhage, and of these 5, one had been bleeding from the rectum for seven days before admission, 2 had had symptoms of hemorrhage for twenty-four hours, one for twelve hours, and the other for six hours. It would appear in these cases that the ulcer was of a very short duration. In 2 other cases the patient had had pain for only nine days before admission, and in neither of these did the hemorrhage occur until after admission to the hospital. From the review of these cases it is seen that bleeding ulcers do occur in patients without previous ulcer symptomatology. It is maintained by some gastroenterologists that blood transfusions are dangerous in bleeding ulcers, and will cause the hemorrhage to continue by raising the blood pressure and dislodging the clot. It can be seen that in Cases I, III, IV and VII that transfusions were not given, and that the patients died. One could argue that if transfusions had been given these cases would not have resulted in a fatality, but Cases II, V, VI, VIII and IX had one or more transfusions with fatal results.

From the autopsy findings in this group of cases it appears that they presented an acute necrotizing process which eroded through healthy vessels at the base of the ulcer. Due to the fact that there had not been a long gastric history with an associated chronic ulcer, inflammatory changes had not taken place which might have resulted in partial obliteration of the vessels surrounding the ulcer. This may be one reason why these cases with a negative history, or a very short gastric history, had a fatal hemorrhage instead of the ordinary chronic recurring hemorrhage.

Surgical intervention could not have been done in any of these cases due either to the extreme condition of the patient, or to the short duration from the time of the hemorrhage to death.

RECURRING MESENTERIC THROMBOSIS

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OBSTRUCTION of the superior mesenteric artery or vein, whether caused by embolism or by thrombosis, produces hemorrhagic infarction of the intestine. This may vary from a few centimeters of small intestine to involvement of the entire small intestine and right colon and if the patient survive sufficiently long, to necrosis and gangrene of the affected gut. The obstruction is said to be more common in the artery than in the vein and occlusion of the inferior mesenteric vessels rarely occurs.

The etiology is not always clear, but it may arise from a source in the left heart or aorta, from arteriosclerosis of the superior mesenteric artery, or from any cause, local or general, favoring venous thrombosis, particularly stasis of the portal system as well as from subacute abdominal infections, such as appendicitis and cholecystitis, dysentery, and so on.

The course of the disease is, first, an occlusion of the mesenteric vessels which gives rise to a series of symptoms simulating perforative peritonitis with abdominal pain which is sudden and usually very severe and constant. The pain is diffuse and later generally becomes localized. Diarrhea is a very constant symptom and blood in the stools is usual, sometimes preceding the onset by several days. When the abdomen is opened, blood-tinged serum will be observed and if the case is not operated upon, a plastic peritonitis may develop, if the patient lives long enough. Shock is commonly very pronounced and the pulse is rapid, the face pinched and white, the expression anxious.

All writers on the subject of mesenteric thrombosis speak of the desperate state of the patient, especially by the time the necessity for operation becomes apparent. It is perhaps the gravest and most hopeless of all abdominal emergencies, partly because the affected gut must be excised and partly and most unfortunately because vascular occlusion generally progresses after operation, so that more intestine becomes involved. In the case about to be reported, it will be perceived that a prompt operation seemingly saved the unfortunate patient's life, snatched him from the grave, dangled false hopes of recovery before his eyes—then with dramatic suddenness and cruel finality, the condition recurred higher up in the mesentery and the curtain was rung down. Thus is justified the statement of the writers on the subject that the mortality is indeed from 90 to 100 per cent.

A résumé of the case follows. The very rarity of the condition renders the personal experience of all but those surgeons having the widest and fullest practice in abdominal surgery of little value statistically, but I feel each case occurring should be reported in medical literature that the aggregate may be studied from time to time.

P. H., a Veterans' Bureau beneficiary, aged thirty-six, white, male, was first seen early in the morning of October 10, 1932, as an acute abdominal emergency. His history, in brief, is that he had not been able to work recently, the cause not being stated. He used alcohol and tobacco in moderation. There was nothing important in the family history. His personal history showed that he had the usual exanthemata as well as malaria, and that he was "shell shocked" in the World War. In May, 1931, he was treated in a hospital for phlebitis of the femoral vein. He had never had an operation or a serious accident.

Nine days before admission he began to have pain in the right groin at or near the site of the previous phlebitis; this later was referred to the right lower abdomen as a steady pain

increasing in severity. The patient did not vomit nor did he feel nauseated. He was treated for indigestion, with castor oil prescribed by his family physician.

Eight days after the onset, the pain became very severe in the abdomen and a physician was again called who gave him morphine by mouth, and as this was vomited the dose was repeated hypodermically. Two hours later this was again repeated and as the condition was then recognized as severe, the tentative diagnosis of acute appendicitis having been made, he was sent immediately to the hospital. The patient was admitted at 6:00 A.M., and I saw him an hour and a half later.

At that time his expression was anxious, and while he was not in very severe pain, it could be seen at a glance that he was very ill. A hasty examination of the abdomen revealed that it was hard and board-like, and practically nothing could be made out upon palpation except that there was more rigidity on the right side and an indefinite mass seemed to be present. Rectal examination revealed nothing. At that time the leucocyte count was 26,000 with 95 per cent polymorphonuclears.

A diagnosis of an acute surgical abdomen was made with a probability of its being a ruptured appendix with peritonitis, or possibly, but not probably, a slow perforating duodenal ulcer. At this time, the diagnosis of thrombosis was not made. The man was prepared for operation, and was given a low enema, which brought away blood-stained fluid.

The patient was operated upon under spinal anesthesia, and after the anesthesia was completed, a very definite swelling could be felt in the right iliac fossa. I then made a positive diagnosis of appendicitis of severe grade with probably an abscess. An incision of the McBurney gridiron type was accordingly made in the right iliac fossa. When the peritoneum was opened there was a gush of blood-stained fluid, and the omentum was everywhere lying adherent to the viscera. The bloody fluid was sucked out and the cecum observed, but the appendix was not seen, nor was a search made for it, since it was appreciated by this time that the diagnosis was at fault.

The incision was slightly enlarged which disclosed close toward the median line, a large loop of purplish ileum. This loop was pulled out of the incision until sound bowel was encountered, proximal and distal, and the affected loop, which was almost black in color, was seen to be about 18 inches long. The line of demarcation between sound and beginning gangrenous bowel was as sharply defined as if it had been painted with a brush.

An examination of the mesentery showed dark shadows resembling small blood clots everywhere in that portion supplying the affected bowel. No further search was made in the abdomen, and due to the incision it was not necessary to expose more than about 3 feet of bowel for the resection and following anastomosis. The affected bowel was resected and a lateral anastomosis performed instead of an end-to-end, as the former was regarded safer in this particular instance. To protect the suture line an ileostomy was then performed a few inches proximal to the anastomosis, a No. 14 catheter being used. This and the anastomosis were covered with omentum and the catheter brought out through the wound, which was closed entirely around it without further drainage.

The man's condition remained very good on the table, but that night his pulse rose rapidly to 150, his temperature to 102°F. For the next seventy-two hours, he was given from 2000 to 3000 c.c. of salt and glucose solution intravenously every twenty-four hours. While for forty-eight hours, his condition was somewhat rocky, he gradually improved, his abdomen remained flat and beyond vomiting once due to a slight dilatation of the stomach which responded to a stomach wash, he did well. The ileostomy tube worked perfectly, and by the fourth day, his pulse had dropped to less than 100 while the temperature was only a degree or so above the normal. He was taking liquids and was sitting up in bed at an angle of 45 degrees.

By the fifth day he was smoking cigarettes and feeling very chipper. He was extremely grateful and said over and over again that he knew his life had been saved by the operation, and he certainly had no idea of dying. I sent his family home by the fourth day, telling them that while I could promise nothing in the case where the mortality is so high, it looked as though this was the one case in ten that got well.

On the sixth day, without any warning, the blow fell. Within two or three hours the man was complaining of intense pain only partially relieved by morphine; his pulse mounted

rapidly to 140, and it was of poor quality; his temperature sank to 97.6°F., and he did not respond to 2000 c.c. of salt solution given within a few hours. He knew then he was dying. Within fourteen hours he was dead, and in all my experience, I doubt if I have ever seen a patient convalescing and in such good shape who faded away so quickly.

The autopsy findings showed what was only too apparent, that a recurrence of the disease was present higher up. The small bowel was found practically gangrenous from a short distance below the ligament of Treitz for a distance of several feet. The autopsy report by Major G. R. Callender, showed:

"*Abdomen:* Beneath the incision, the omentum is adherent and walls off what appears to be two loops of the terminal ileum which are anastomosed laterally. Portions of the loops are adherent by thin, fibrous adhesions. There is a small pocket of pus, estimated at 3 c.c., between the anastomosis and the omental covering. The mesentery to the anastomosis appears clear and free from venous block. There is about 500 c.c. of thin bloody fluid found in the abdomen and about 200 c.c. in the pelvic cavity.

On reflecting the omentum, four coils of jejunum are practically black, with a rather ill-defined separation between the gangrenous and normal intestines. This area begins in the third loop of the jejunum and extends over into the upper third of the ileum.

Dissection, following removal of the abdominal contents *en masse*, shows all tributaries of the superior mesenteric vein supplying the small intestine to be filled with rather soft red clots. At the separation of the first large free mass, 5 cm. long and 0.5 to 1.3 cm. in diameter, is found lying in the portal vein as it enters the liver. The splenic vein is clear, as are those from the stomach. Considerably older adherent thrombi are found in the vessels of the anastomosed area.

Liver: The liver is deep yellow in color, opaque and friable.

Spleen: The spleen is considerably enlarged and shows a rather marked increase in splenic tissue.

Kidneys and Adrenals: Appear essentially normal.

The rest of the organs appear normal.

Note: The cause of the primary involvement in the ileum, for which operation was done, cannot be determined at this autopsy. The freedom of the mesentery from obvious thrombi suggests that a twist might have been present. The terminal picture is that of massive venous thrombosis, secondary to an embolism from one of the tributaries, the final clotting being due to obstruction of the portal vein at the liver."

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*Continued from p. 304.

MESENTERIC CYST*

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FLYNN, as quoted by Warfield,[1] states that mesenteric cysts are the rarest tumors occurring in the abdomen.

The classification of these tumors varies according to the author but the classification of Dowd[2] is the one most widely accepted. In his first article Dowd noticed the close embryonic relationship of the wolffian body and the root of the mesentery. He suggests that sequestrated cells from the wolffian body might be displaced forward into an intramesenteric position and later develop into a tumor. He also suggested that sequestrated cells from the developing duct might likewise be displaced between the leaves of the mesentery and develop into a cyst.

Bland-Sutton[3] says: "the human body contains certain tubes which, so far as it is known, serve no useful purpose in the adult, and may be called in consequence functionless ducts" and Eisendrath[4] includes the vitello-intestinal duct and Meckel's diverticulum. Rarely a cyst forming in the vitello-intestinal duct may have no connection with the gut, the cyst arising in the mid-portion of the duct, the proximal and distal ends being occluded.

Cysts identical with the structure of the gut but yet having no communication with the gut have been described by Hunter,[5] Eve[6] and Shallow.[7] Gteller[8] describes these cases as arising in connection with an unobliterated omphalomesenteric duct by separation of the intestinal anlage by germinal displacement.

Higgins and Lloyd[9] say: (1) True mesenteric cysts are not malignant, paracitic or dermoid but form a separate group in which are included the majority of all "mesenteric cysts." (2) Their origin is still in doubt, but it seems probable that there are two classes: (a) cysts of embryonic origin arising from mesodermal remnants, incarcerated between the developing peritoneum and subsequently migrating forward between its layers; (b) cysts of intestinal origin (1) arising in most cases as diverticula from the bowel during development, (2) possibly derived sometimes from persistent portions of the vitelline duct. (3) Anomalous and heretofore unclassified cysts, such as pararenal cysts.

The classification of Dowd is based on the genesis of mesenteric cysts:

1. Embryonic
   - Dermoid
   - Serous
   - Chylous
   - Hemorrhagic
   - Enteric
2. Hydatid
3. Malignant.

Ewing, quoted by Dowd, believes that some mesenteric cysts are acquired, especially the chylous or lymphatic types, and the theory of lymph stasis resulting in dilatation and rupture of the lymphatic vessels is very applicable. Klemm[10] states that the cyst wall of the true chylous cyst is made up of tissue arising from the mesoderm, and so must be of embryonic origin. Ewing[11] states that Klemm and Rittner interpret all mesenteric chylous cysts as cystic lymphangiomas, and he further states that the so-called serous cyst probably represents a rare form of other varieties of this group.

DIAGNOSIS

That correct diagnoses have been made is shown in Warfield's article. He further states that there are no pathognomonic signs or symptoms, that an abdominal tumor that is rounded, smooth, not tender,

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cystic and quite mobile, especially in a transverse direction, is suggested. Pain is more frequently present than with any other type of abdominal cystic tumor.

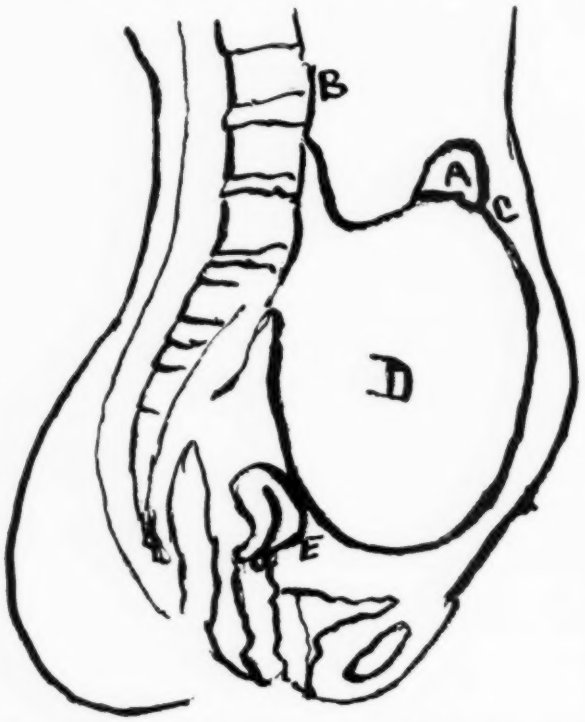

FIG. 1. Sagittal section. A, ileum. B, parietal peritoneum. C, visceral peritoneum. D, tumor. E, uterus.

Differential Diagnosis: Ovarian cysts, retroperitoneal tumors, pancreatic cysts, intestinal new growths, pedunculated uterine fibroids, movable kidney, hydronephrosis, hydrops of the gall bladder, ascites, tuberculous peritonitis, pregnancy, acute peptic ulcer, extra-uterine pregnancy, ruptured pelvic or tubal abscesses, acute peritonitis, acute pancreatitis and acute diverticulitis must be ruled out.

One of the most common symptoms is partial or complete intestinal obstruction. Fifty per cent of these tumors are unilocular, 50 per cent occur in the small intestine (the larger portion occurring at the terminal portion of the ileum), and 33 per cent are complicated by intestinal obstruction.

Moynihan, quoted by Judd,[12] observed that emaciation was particularly rapid in a case of chylous cyst.

They occur at all ages, most frequently, however, at puberty. Peterson[15] affirms that despite their rarity about 500 cases have been reported.

TREATMENT

The treatment consists of enucleation, resection, marsupialization or aspiration. Flynn[13] and Swarthy[14] say marsupialization is obsolete.

CASE REPORT

B. M. was admitted to Greenpoint Hospital June 24, 1933, complaining of pain in the back, fever and general weakness.

Present Illness: The last menstrual period occurred September 20, 1932. On June 2, 1933 the patient was delivered at home by a mid-wife of a living child. The labor, twenty hours in duration, was spontaneous and uncomplicated. The puerperium was normal until the patient got out of bed which was on the tenth day, when she noticed that her abdomen was swollen and tender and she also thinks she had a fever. There was also pain in the back and general weakness. She called a doctor who treated her for kidney trouble. As she did not improve she called another doctor the following day and was told "she had pus on the kidney." Days passed and as there was no improvement she called a third doctor who sent her to the Greenpoint Hospital; this was twenty-two days after delivery. The patient states she thinks her abdomen was about the same size as when first noticed on the tenth day. She had been bleeding since delivery and for the last week had been using about two pads a day. This bleeding was not associated with clots or cramps. At times the patient could not urinate without taking "parsley tea." On urination she experienced severe sharp pain in both sides of her abdomen which at times made her "weak and faint." The bowels were constipated but there was no pain on defecation.

Past Personal History: This was essentially negative for childhood diseases or operations.

Marital and Menstrual History: The husband is alive and well. She had been married two years, Parai, no abortions. Periods first occurred when she was sixteen years old, and were of the twenty-eight day variety, lasting three to four days with comenstrual pain. This pain was noticed only after marriage. She also

said she had a moderate vaginal discharge first noticed after marriage.

Physical Examination: The patient is a white female aged twenty-one, apparently suffering no pain. Findings were negative except the abdomen which revealed on inspection a slight symmetrical swelling below the umbilicus. There was no visible peristalsis, no dilated veins and the umbilicus was not protruding. Palpation revealed a round cystic tumor which apparently arose from the pelvis and extended to the umbilicus. It was movable, especially from side to side. There was some tenderness on motion. No other tumors or organs were palpable.

The outlet was multiparous, with no external evidence of infection and a good pelvic floor. The cervix was anterior, closed, soft and not tender. The fundus was completely retroverted but could be replaced forward for a distance of 4–5 cm. when its further progress was blocked by a cystic tumor that partly filled the pelvis. Involution was good. The right ovary was palpable. The left was not palpable. There was no demonstrable parametrial pathology. Extremities were negative.

Laboratory Reports: Urine: catheter specimen. Color orange, reaction neutral, specific gravity 1.019, definite reduction of sugar, faint trace of albumin, microscopic negative for pus. Wassermann reaction on admission 4+. One month later 1+. Blood: erythrocytes 3,200,000, hgb. 60 per cent, sedimentation time thirteen minutes. B.P. 115/65. Further laboratory data, save for the presence of sugar on July 3, were negative.

Diagnosis: Ovarian cyst, left, with probable twisted pedicle.

Operation: June 28. The usual midline incision between pelvis and umbilicus was made. When the abdomen was opened a round glistening pearl grey tumor presented. No omentum was seen. It was noted at this time that many large vessels coursed over the tumor in marked contrast to the usual ovarian cyst. An attempt was made to deliver the tumor but without success, except it could be displaced cephalad for a few inches. Further examination revealed the lower part of the ileum encircling the tumor on its upper border for a distance of 8 inches and it was further noted that the peritoneum covering the tumor also extended over the gut. It was then realized that we were dealing with a mesenteric cyst. As there were no signs of compression or angulation of the gut and as the cyst wall was extremely thin it was deemed advisable to marsupialize, drain and pack. A trochar was introduced through the cyst wall and about 500 c.c. of fluid evacuated. The cyst wall was then easily delivered as far as the rectus fascia and it was again found that no distortion of the encircling gut was caused by this manoeuver. The remaining contents of the cyst, about 500 c.c., were evacuated. The peritoneum was then closed and also sutured to the cyst wall. A small piece of the cyst wall was then removed and the edges of the collapsed cyst were sutured to the fascia of the rectus. Inspection of the cyst cavity showed it to be extremely thin walled and no line of demarcation could be ascertained between the true cyst wall and the covering peritoneum. One point of interest was noted and that was the broad separation of the leaves of the mesentery at the base of the cyst cavity. The cavity was packed with dry iodoform gauze.

Laboratory Report: Fluid contents of cyst: The fluid is amber in color and shows a slight sediment of blood. Culture and smears are negative for organisms.

Pathological report of the cyst wall: It shows a blood clot and strands of necrotic, disintegrated tissue, the origin of which is not discernible.

The *postoperative course* was not particularly stormy. The temperature ranged from 99.9° to 104°F. and then fell by lysis, reaching normal on July 18. The pulse varied with the temperature, the highest recorded being 120.

There was profuse drainage for the first six days at which time the drain was removed. The cyst cavity was swabbed with silver nitrate 5 per cent and then repacked. After another three days the cavity was again packed and this was repeated daily until July 18. After the two first packings the cavity began to diminish in size until on July 18 it was found closed.

The patient was discharged on July 31 at which time the incision had healed completely and examination revealed a negative abdomen to the examining hand. The patient has remained well to date.

On discharge the patient was referred to the genitourinary department for further check on her Wassermann reaction. Repeated tests were negative despite the fact that the patient received no treatment.

In conclusion one must point out that although these tumors are rare they should be kept constantly in mind and properly evaluated, as often the operation is technically easy and more extensive operations may be avoided if the simple methods of enucleation of a cyst wall or marsupialization be remembered.

The literature will bear me out in the fact that marsupialization is not an obsolete method of dealing with these cysts.

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INTRACRANIAL ARTERIOVENOUS ANEURYSM*

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ABNORMAL communication between the internal carotid artery and cavernous sinus is a relatively infrequent sequela of skull fracture, though such an injury is the most common etiological factor in the production of this condition. In addition to its relative infrequency, certain unusual features of a case recently observed have prompted this report.

Locke,[1] in 1924, presented an excellent review of the subject, collecting 131 cases. This brought, since Travers' first case in 1809, the total number of recorded cases as of June, 1923, to 588. Jennings[2] added 8 cases to those collected by Locke; Harkness[3] collected 33 cases (including one of his own) from the time of Locke's report until 1927, making a total of 621 cases. Since then there have been more than 25 additional cases reported, including those reported by Esteban,[4] Hallet,[5] Terrien,[6] König,[7] Verkerk,[8] Barco,[9] 3 cases by D. and E. Lazarescu,[10] Schneider,[11] 2 cases by Baurmann,[12] and Wertheimer.[13]

Fully 75 per cent are traumatic in origin, usually being associated with sphenoidal fracture. The majority of traumatic arteriovenous aneurysms occur in males. For a rather complete discussion of the historical, etiological and pathological phases of the subject, one might well consult Locke's contribution.

Numbers of varying therapeutic measures have been suggested for the treatment of intracranial arteriovenous aneurysm. Rhodes, quoted by Reid and Andrus,[14] collected 14 different methods, chief among these being ligation of the common and internal carotid arteries, and the supra-orbital veins. Locke[1] also considered the various therapeutic measures recommended including subcutaneous injection of gelatin (Lancereaux and Paulesco). He concluded that "the beneficial results from these various forms of treatment are dependent upon the decrease of blood going to or from the arteriovenous fistula, without diminishing the blood supply of that side of the brain sufficiently to cause death or hemiplegia." He made no mention of simultaneous ligation of the internal jugular vein, but from a study of the various methods recommended he prefers ligation of the internal carotid after a test period of compression. Kerr[15] has advised fractional ligation of the common carotid artery, utilizing a flap of fascia. The caliber of the artery is reduced 50 per cent and if nothing unfavorable develops, the artery is later tied off. Neff,[16] more than twenty years ago, devised a very ingenious clamp to be placed on any big artery and left in situ. As catgut, placed to keep the blades apart, was gradually absorbed, the blades would slowly come together, thus gradually occluding the vessel. Jennings[2] believes this method the treatment of choice in the management of intracranial arteriovenous aneurysms (the clamp being placed on the common carotid artery), with ligation of the superior or inferior orbital veins if necessary.

Dorrance[17] has advised ligation of the common carotid, and within a week or two, ligation of all the branches of the external carotid, excepting the internal maxillary and superficial temporal. Campbell and Martin[18] have advocated *partial* ligation of the internal carotid artery, using a fascial band as the constricting agent.

Reid and Andrus,[14] from certain theoretical considerations, have recommended ligation of the common carotid of the

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affected side, as well as the external carotid artery and internal jugular vein, and their reasoning is rather convincing:

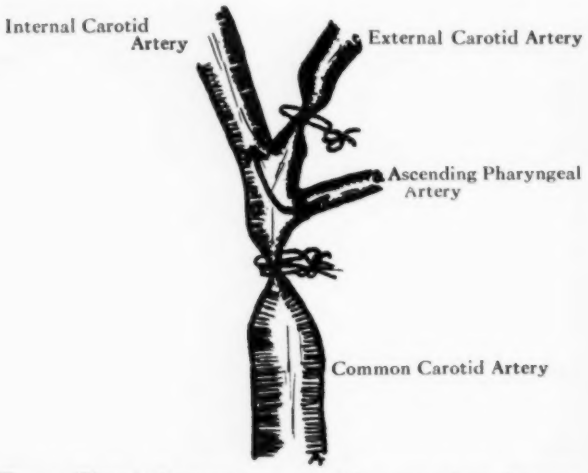

FIG. 1. Sketch illustrating probable cause of persistency of arteriovenous aneurysm.

If the common carotid artery is alone ligated, there remains a free communication between the internal and external carotid arteries through which blood could flow in either direction. Similarly, if the internal carotid artery is ligated, anastamosis between the branches of the external carotid artery and the intracranial vessels (particularly about the eye) would tend to preserve a circulation through the fistula. Ligating both external and internal carotid arteries would check the arterial circulation as effectively as the method advocated, but the latter procedure has these advantages: the internal carotid is a little more difficult to isolate than is the common carotid, and, in case of cerebral disturbances, a band can more easily be removed from the common than from the internal carotid artery.

Simultaneous ligation of the internal jugular vein serves a twofold purpose: lessening the likelihood of a cerebral complication and further tending to slow the current through the aneurysmal site. It is a rather well-established principle of vascular surgery that simultaneous ligation of its venous satellite, when arterial occlusion is effected, seems to maintain a more efficient vascular tension and that therefore untoward results are less likely to ensue.

Despite the logic of the foregoing, Guazzieri[19] has recently reported 2 cases treated by ligation of only the common carotid artery and internal jugular vein

FIG. 2. Patient several months after disappearance of aneurysm; left eye is more or less fixed in this position.

in which he claims to have obtained excellent results.

All of these measures attempt to slow the current through the aneurysmal area, a more or less generally accepted principle in aneurysmal therapy since the time of Anel. Babcock,[20] in accordance with his well-known revolutionary concepts of acceleration of the current in aneurysmotherapy, has suggested treating intracranial aneurysms by anastomosing the cerebral end of the cut common carotid to the cardiac end of the cut internal jugular vein, on the side of the aneurysm. The cerebral end of the vein and cardiac end of the artery are ligated. However, Dr. Babcock's principles have not gained widespread acceptance and, in fact, have met with considerable dissent, both on clinical

and experimental grounds, because of untoward effects from such radical alterations in the circulation. These objections have been expressed by Matas[21] in his characteristically masterful style, discussing, however, a slightly different procedure.

In the case herein reported, it was decided to follow the suggestions of Reid and Andrus. Because of an anomalous condition, the significance of which we failed to realize fully, our immediate results were somewhat disappointing, though probably paving the way for an unusual, semi-spontaneous cure.

CASE REPORT

The patient, a white male aged twenty-seven, was first seen by us on September 26, 1931.

History: He gave the history that two months previously (July 26, 1931) he had crashed in an aeroplane, being rendered immediately unconscious. He remained unconscious for about three days after the accident, at which time he was found to have a retrograde amnesia, recalling nothing that had transpired for thirty minutes prior to the fall. From the moment of returned consciousness he had been aware of a roaring pulsation in his head. Three weeks later, the initial edema having subsided, his left eye again became swollen, red and began to bulge. Vision in this (left) eye had gradually been failing since the recovery of consciousness, and two to three weeks prior to admission, both eyes had begun to rotate inward, producing a bilateral internal strabismus.

Chief Complaint: When first seen by us his chief complaints were roaring in his head, loss of vision and bulging of the left eye. The mild headache and occasional vertigo which he experienced were not particularly disturbing. The noise was characterized as roaring in character, rhythmic, occasionally disappearing for short periods. This appearance and disappearance were apparently uninfluenced by position or anything else which he had been able to determine.

Physical Examination: The essential findings were as follows: There was a bluish-black discoloration around the left orbital regions, with a moderate degree of exophthalmos of the left bulb. The conjunctival vessels were moderately injected; palpation directly over the left bulb revealed a distinct pulsation synchronous with the apical beat; the left eye was rotated inward to a marked degree and apparently fixed; the left pupil was moderately dilated and unreactive. The right bulb and periorbital region were grossly normal excepting for a slight post-traumatic (not of recent origin) defect in the iris. The bulb was turned inward to a somewhat less degree than the left and a slight amount of external rotation was possible. The right pupil was reactive directly and consensually. Auscultation over the left bulb and left temporal region revealed a bruit synchronous with the apical beat; no bruit could be heard elsewhere about the head. Fundal examination revealed bilateral tesselation with a normal right disc, but the left showed the typical picture of primary optic atrophy, with practically no residual vision in this eye. The retinal artery and vein of the left eye showed marked tortuosity and dilatation. Vision in the right eye was scarcely impaired. Pressure over the left common carotid caused abolition of the head noise, the pulsation and the bruit; release of this pressure was accompanied by immediate return of these abnormalities. Pressure over the right common carotid, while causing a slight decrease in the intensity of the roar did not cause its disappearance.

A skiagraph (Dr. Edwards) revealed a fissured fracture of the petrous portion of the temporal bone; no definite fracture of the sphenoid was visualized.

Diagnosis: From these data, we naturally concluded that we were dealing with an arteriovenous aneurysm between the left cavernous sinus and internal carotid artery, bilateral abducens palsy, primary left optic atrophy.

Surgical therapy was advised and accepted. However, a preliminary period of digital compression of the left common carotid was deemed advisable to facilitate the development of collateral circulation sufficient to minimize the danger of cerebral catastrophe following ligation. The patient was taught how to compress the left common carotid, thus closing off the circulation through the aneurysmal site, which he was able to detect by disappearance of the head noise. He diligently practiced this for thirteen days: at the onset, he was unable to maintain pressure but for a few moments before vertigo or paresthesia developed, but by the end of this period, compression could appar-

ently be continued indefinitely with no ill effects. Only then was ligation deemed safe.

Operation: When we were satisfied that he had developed sufficient collateral circulation, the patient was subjected to his first operation, on October 8, 1931, a little more than two months after the original accident. Under local analgesia a 3-inch incision was made along the anterior border of the left sternomastoid. The carotid vessels and jugular veins were well exposed. An anomalous condition was noted at this time, but we failed to realize its significance and modify our procedure accordingly; we were to regret this later. The first branch of the carotid system (which we identified as the ascending pharyngeal) arose from the common carotid just below its bifurcation instead of from the external carotid. We have no excuse to offer for failing to realize its potentialities. Silk ligatures were placed around the internal jugular vein and external carotid artery; a rubber-tipped tongue forceps was used to compress the common carotid for a period of twenty-four hours, the handle being left protruding out of the sutured wound. This was probably an unnecessary and not entirely safe precaution. The patient was kept absolutely quiet for twenty-four hours; he suffered no ill effects whatsoever. The noise had been completely obliterated by the operation, but he noted an occasional head noise similar to that heard prior to operation. The next day the wound was reopened and the clamp replaced with two silk ligatures.

Course: That night an occasional head noise was heard. Gradually, there was an intermittent recurrence of the noise, which became more frequent and more pronounced. At first, it was only noticeable in the recumbent position, but later it was noticed at frequent intervals and not influenced by position. It recurred spasmodically, disappearing equally as suddenly, and the patient was unable to determine what influenced the change. However, whenever the noise disappeared, or when it recurred, the change was initiated by a *popping sound in the ears.* In retrospect, the anomalous position of the ascending pharyngeal was recalled. It was then realized that this vessel had probably gradually dilated, permitting blood to again flow through the site of the aneurysm; as it gradually became larger the noise became louder (see Fig. 1). The occurrence of the "popping" sound we were able to explain only by the assumption of a "flap" which would open and close intermittently, influenced by fluctuations in intravascular tension, establishing or obliterating the fistula thereby.

Reoperation: Therefore, on October 29, 1931, three weeks after the first operation, the patient was readmitted for re-exploration and ligation of the ascending pharyngeal or internal carotid artery. Although the original wound had healed *per primam,* structures were enmeshed in soft fibrous tissue, making it extremely difficult technically to identify them. To quote from our operative record of that date: "The old incision is re-opened; careful dissection is made until the common carotid is located; fibrous tissue makes it impossible to identify structures properly. The ligatures, however, appear to be loose around the common carotid, so several pieces of silk and catgut are used to religate the common carotid. An attempt is now made to trace this vessel up to the internal carotid, but the jugular vein or its communications have been so displaced that every attempt to free the internal carotid opens fresh avenues of venous bleeding. After the common carotid has been ligated patient states that the noise is absent, and it is thought that perhaps, after all, the recurrence has been due to a leak through the common carotid, and because of the technical difficulties encountered, further attempts to isolate the internal carotid are abandoned."

The patient had no sooner been transferred from the operating table to the stretcher than he noted a recurrence of the head noise! Although less in intensity than originally, the head noise, pulsation and bruit persisted, disappearing and reappearing spasmodically; the noise was characterized as more of a "squeak."

Four days later (November 2, 1931) another attempt was made; this time an effort was made to reach the internal carotid from another angle, it being hoped that some of the scar tissue could be thus avoided. To again quote from our operative record: "A 4-inch incision is made about 2 inches posterior to the former incision, and extending 2 inches farther up than the first incision. An attempt is made to identify the internal carotid, but dense scar tissue so distorts the anatomy that it is impossible to locate or identify structures. No definite pulsation can be felt to aid identification and the noise disappears and reappears at irregular intervals, whether or not pressure is being made on the structures, and so it is impossible to

locate the vessel that is allowing blood to flow through the aneurysmal site." The operation was, therefore, abandoned.

The wound healed *per primam* and on November 11, 1931 the patient was again discharged apparently somewhat improved. The head noise was inconstantly present as a little "squeak." Though no vision was returning to the left eye and its internal rotation was unrelieved, the right eye was turning out again and could be brought to the midline. The exophthalmos had receded as had the discoloration, swelling, etc., in the left periorbital region. It was hoped that the current had been sufficiently slowed to permit thrombosis at the fistula.

Course: The patient was not seen again for about eight months. On July 23, 1932 he reported for the first time since discharge. In the interim he had been doing well enough: he had re-secured a pilot's license and a radio license. The noise was described as present more or less constantly though not very loud, and he had become adjusted to it so that it did not actually disturb him any. The right eye had completely recovered its movement and its sight; the left eye remained blind and internally rotated. The noise was apparently *exaggerated by exercise*. Examination showed a definite, though slight, exophthalmos of the left eye, with an Argyll Robertson pupil. A slight bruit could be heard over the left eye. Pressure over the cervical scar caused obliteration of the head noise, bruit and pulsation. A Locke-type of compression collar was advised to see if this might not aid in complete closure of the fistula, by further slowing the current and facilitating thrombosis.

The patient returned home, built the collar and used it for a few days. One day (August 13, 1932) while on a picnic an automobile got bogged in the mud and he, with several others, got out to push the car. While straining and lifting the noise became quite intense. Suddenly, he realized that the noise had disappeared; nor has it recurred to the present writing, seven or eight months later, and there is every prospect of its continued absence. He has, moreover, been able to slightly rotate his left eye outward and the bruit, pulsation and exophthalmos have completely subsided.

We have tried to explain this chain of events on the basis of a flap, the edge of the injured vessels, which in some way, as the result of the greatly increased intravenous pressure from straining, became jammed shut and thus caught. Such a flap would explain the "popping" sound heard when the noise would previously appear and disappear. Whatever the explanation, the arteriovenous fistula seems to have completely closed, and can hardly be explained on the basis of a thrombus formation.

At present, he has been attempting to overcome the left abducens palsy. If he fails to completely recover ability to bring the eye to the midline, no doubt an operative procedure to re-align the eyes will be in order. There seems to be no hope for recovered vision in his left eye. We have felt that the operative therapy was of benefit inasmuch as it slowed the current to such a degree that such an unusual cure was possible; otherwise the force of the current may have kept the flap open.

SUMMARY

A rather typical case of post-traumatic intracranial arteriovenous aneurysm is presented, with a description of attempts at operative relief, and in which an unusual, semi-spontaneous cure ensued.

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[For Remainder of References see p. 324.]

A CONTRIBUTION TO THE SUBJECT OF CEREBRAL EMBOLISM OF PULMONARY ORIGIN*

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THE occurrence of cerebral embolism of pulmonary origin, though not frequent, is a familiar phenomenon in cases of chronic lung infection.

In pulmonary tuberculosis, bronchiectasis, and lung abscess there are several pathological conditions in common, viz:

1. There is an infection in the lung.
2. There are varying amounts of fibrous tissue which traverses the lung and renders it firmer and less elastic than normal.
3. There are usually adhesions between the visceral and parietal pleurae which prevent collapse of the lung when the chest wall is penetrated.

The relative importance of the factors in the production of embolus in these diseases is difficult to evaluate. Is infected lung essential? Is stiff fibrotic lung necessary in order to hold open a severed pulmonary vein? What part is played by adhesions between visceral and parietal pleurae?

From June 1, 1931 to May 31, 1932, 81 cases of penetrating stab wounds and bullet wounds of the chest were admitted to the surgical service at the Harlem Hospital. Exploratory thoracotomy was performed in all but 6 cases. In 2 cases in this large series, cerebral embolism occurred. The striking fact is that *in both these cases, and in no other case*, fibrous adhesions held the lung fixed to the chest wall and completely obliterated the pleural cavity in the region of the penetrating wound of the lung.

CASE REPORTS

CASE 1. E. N., male, thirty-five years old, was admitted to Harlem Hospital, October 9, 1931 and was discharged December 7, 1931. He was stabbed in the back with a long bread knife in the left seventh intercostal space, 1½ inches from the spinal column. The wound bled freely and in addition there was a hematoma of the chest wall about it. Subcutaneous crepitation could not be felt but was heard through a stethoscope when pressure was made with it. The roentgenogram showed a shadow over the lower half of the left chest which suggested fluid in the pleural cavity.

Operation was performed soon after admission for the purpose of controlling hemorrhage. About 3 inches of the seventh rib was removed and the intercostal vessels ligated. The lung was adherent to the parietal pleura and the adhesions completely obliterated the pleural cavity in the region of the wound so that no "free" pleural cavity was seen. There was a gaping laceration in the lung forming an excavation about 2½ inches in diameter, and in it was a spurting vessel. The lung tissue appeared normal in appearance and consistency. Bleeding was controlled by suture and the cavity was packed with iodoformized gauze. Gas and oxygen anesthesia was administered but the anesthesia was not deep and the respiratory excursions were wide and vigorous.

The *postoperative recovery*, as far as his cardiorespiratory system was concerned, was excellent. His temperature became normal in six days and remained normal. But when he recovered from the anesthetic he was blind (except for light perception) and he had a motor paralysis of the right arm and leg. Sensation was not disturbed. The pupils were dilated, equal, and reacted slightly to light. There were no retinal changes. The Kahn reaction was one plus. Spinal puncture ten days after admission to the hospital produced clear fluid under slightly increased pressure, containing 1 cell per c.mm., a trace of globulin and a trace of sugar.

Blindness persisted for six days and vision then returned slowly, so that four days later he was able to distinguish objects. The paralysis did not clear up as rapidly as the blindness. Although beginning motion in arm and leg was noted three weeks after operation, there was a

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paresis and incomplete function one year afterwards.

Careful questioning after recovery elicited no history of pleural or pulmonary disease.

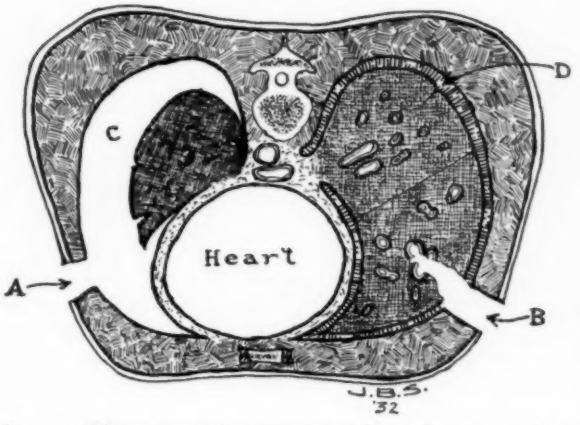

Fig. 1. Diagrammatic representation of cross section of thorax. A. Large thoracotomy wound into a normal pleural cavity. C. Lung and pulmonary vessels collapsed by positive pressure in pleural cavity. B. Large thoracotomy wound in case in which pleural cavity (D) has been obliterated by fibrous adhesions. Lung cannot collapse. Veins cannot collapse and when they are severed, air or blood clots may enter and be sucked into heart and thence proceed to brain.

Case II. F. P., male, sixteen years old, was admitted to the Harlem Hospital March 12, 1932 and was discharged April 6, 1932. He had been shot in the chest about one hour before admission. He was dyspneic and breathed rapidly. The pulse was rapid, regular, and of good force. A bullet wound of entrance was present in the second right intercostal space about 1½ inches from the sternal border. No point of exit was found. Below the angle of the scapula on the right side was a scar of an operation performed eleven years previously for empyema thoracis.

A roentgenogram showed a bullet present in the chest and an opaque shadow in the region of the bullet wound.

Operation was performed March 12, 1932, at 6 P.M. A 3 inch semicircular incision was made part way around the bullet hole and 1 inch below it. A skin flap was dissected upward until the hole in the pectoralis major was exposed. The muscle was bluntly dissected in the direction of its fibers. About 3 inches of the third rib was removed and the rent in the parietal pleura was enlarged. The lung was firmly fixed to the parietal pleura by the adhesions which apparently were due to the pre-existent empyema thoracis. No opening into a "free" pleural cavity was seen. The lung tissue seemed normal in consistency and in appearance. The hole in the lung was about

Fig. 2. A roentgenogram in Case II. There is a shadow over right upper lobe in region of bullet wound. This shadow is due to extravasation of blood. Obliteration of pleural cavity by adhesions has prevented gravitation of blood to costophrenic sinus and to region of lower lobe. Thus there is no shadow of dependent fluid in pleural cavity.

¾ inch in diameter. Dark clots of blood and foaming fluid blood oozed out with expiration and were sucked in with inspiration. Blood appeared at the mouth although there had been none before operation. The hole in the lung was packed with gauze. The anesthetic was gas and oxygen and as in the first case, the respirations were rapid and vigorous.

March 13, 1 A.M. Although the anesthetic had been gas and oxygen, the patient was in a deep coma, breathing stertorously and rapidly. His face was cyanotic. Loud mucous râles were heard throughout the chest. The pulse was rapid, varying in force and rhythm and at times was imperceptible. A small amount of mucosanguineous material was obtained by aspiration from the throat.

The patient was placed in an oxygen tent, and was given stimulants and physiological saline solution intravenously.

3 A.M. Respirations were labored but regular. The pupils were constricted and did not react to light. There was no nystagmus or lateral gaze. There was puffing of the right cheek on expiration. The patient was in deep coma with all limbs flaccid. Frequently he became pulseless and seemed in extremis but his condition improved after infusions of physiological saline solution.

March 14, 9.30 A.M. The patient was still comatose. In addition to the weakness of the right side of the face there was a noted weakness of the right arm, but there was no complete paralysis.

March 15. The patient slowly became conscious. He was very irritable, weeping and crying out with slight provocation. For the first time he was able to see and count and speak slowly. He could be awakened easily but soon sank into deep sleep. There was still slight weakness of the right arm. The facial weakness had improved. He had occasional twitching of the head and of the right arm. He was incontinent. He had received fluid by hyperdermoclysis and by infusion but on this day he began to drink fluids.

Slowly his abnormal symptoms improved. Temperature of 102°F. to 104°F. persisted for nine days after operation and gradually returned to normal in the next five days. The irritable emotional state was present for about nine days and slowly disappeared. On the day of discharge from the hospital there was slight lower facial weakness and weakness of the right arm. His general condition was excellent. The muscular weakness disappeared in approximately one month after discharge from the hospital. He was seen at intervals until October, 1932 and remained quite normal.

There are marked similarities in these two cases:

1. Obliteration of the "free" pleural cavity by adhesions causing the lung to be fixed to the parietal pleura. In one case it was due to an empyema thoracis eleven years previously and in the other the etiology was unknown.

2. Absence of suppurative process in the lung. The lung grossly appeared normal.

3. Penetration of the lung parenchyma with free bleeding, i.e., opening of vascular channels.

4. Failure of the lung to collapse because held fixed to the chest wall by adhesions.

5. Vigorous respirations during the administration of gas and oxygen anesthesia.

6. Cerebral insult as indicated by coma, blindness and peripheral paresis.

Since both patients recovered, the exact nature of the pathological condition cannot be stated. We believe, however, that a definite sequence of events existed. The severed lung did not collapse because it was firmly fixed to the chest wall by adhesions. Under normal circumstances, air entering the pleural cavity through a wide thoracotomy wound causes collapse of the lung and usually a comcomitant collapse of the blood vessels. This becomes a protective mechanism since the bleeding tends to stop and particles of foreign solid matter or of air cannot enter the collapsed blood vessels. In both cases with the fixation of the lung to the chest wall, the blood vessels were held wide open. Due to the violent excursions of the chest wall a strong bellows-like action was produced which allowed air or blood clot (or both air and clot) to enter the pulmonary veins and proceed thence to the heart and to the brain.

Some have recommended that cerebral emboli of pulmonary origin particularly of air might be avoided if the patient were placed with the head on a lower level than the chest. This does not seem logical because air or solid particles, we believe, *do not run into* the severed pulmonary veins but must be introduced or sucked into the blood vessels with some force. Violent respirations in cases in which visceral and parietal pleuras are adherent can produce the forceful sucking action and render useless the theoretical advantage of the Trendelenburg position.

It is probably more than a coincidence that these two patients developed cerebral emboli. We believe it demonstrates that cerebral embolism of pulmonary origin may be produced during operation independent of pulmonary infection and gross fibrous changes in the lung but dependent mainly upon the diffuse and firm adhesion of the lung to the parietal pleura.

TRAUMATIC SHOCK SYNDROME FOLLOWING RUPTURE OF AORTA & MULTIPLE FRACTURES*

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IN view of the present-day controversy as to whether traumatic shock is caused by a toxemia from the damaged tissues[5,6] or by other factors,[2,7] the following case is of interest. In it, the clinical picture resulting from rupture of the aorta and other injuries was that of "shock."

The condition of traumatic rupture of the aorta is a relatively unusual complication of severe chest injury. Two cases are contained in the literature of the past five years,[1,4] while spontaneous ruptures are more commonly reported. Indirect traumatic ruptures, presumably by hydrostatic pressure, are also described.[3]

CASE REPORT

C. S., a white female aged fifty-eight years, was admitted to the University of Chicago Clinics on December 1, 1932, immediately after being pinned between two automobiles. A rapid physical examination indicated that the patient was in "shock." The pulse was rapid and only faintly palpable, the skin and lips pale, and the hands and feet cold and slightly cyanotic; the patient was conscious but dazed, and complained of no pain. The blood pressure on admission was 50/40 mm. Hg. There was found a compound fracture of the left leg, a large hematoma of the right leg, and minor contusions and abrasions elsewhere. Examination of the chest and abdomen failed to reveal signs of visceral injuries.

Immediate anti-shock treatment was instituted; external heat was applied, 1500 c.c. of Ringer's solution were given subcutaneously, and thirty minutes later 1000 c.c. of physiological saline solution were given intravenously. The latter resulted in a transient rise of the blood pressure to 70/40 mm. Hg. Approximately four hours after admission 350 c.c. of compatible citrated blood were transfused, and the blood pressure rose to 75 mm. Hg systolic. The wound of the left leg was then sutured without anesthesia, and the fractures of the left tibia and fibula easily reduced under fluoroscopic control, without noteworthy change in the clinical condition. The erythrocyte count was at this time 3,550,000, and the leucocyte count 28,000.

The pulse rate gradually increased during the next three hours to 150 per minute, and the respirations to 48 per minute, while the blood pressure slowly fell to 50/30 mm Hg. About eight hours after admission the patient rather suddenly lost consciousness, the pulse nearly disappeared, and respirations ceased.

In the absence of local signs of visceral injury or of internal hemorrhage, the clinical diagnosis was made of "traumatic shock" complicating multiple fractures.

Necropsy revealed a transverse rupture 3 cm. long through all coats of the aorta at its arch (Fig. 1); there was a small thrombus attached to one angle of the tear, and the mediastinum was tensely infiltrated with blood. The aorta showed slight atheromatous changes, but little or no involvement at the site of rupture.

There were thirteen fractures of eleven ribs, none of which were at all related to the rupture of the aorta. The sternum was fractured, and there was a small amount of blood in both pleural cavities. The pelvis, and the left tibia and fibula were also fractured with moderate hematoma formation. There were no discoverable fractures of the skull or vertebrae, but there was a slight cranial subarachnoid hemorrhage. Small hemorrhages were present in the cortex of each adrenal. There was a large hematoma of the right leg, and smaller bruises with ecchymosis elsewhere.

Microscopic examination revealed moderate pulmonary fat embolism, and dilatation of the cerebral vessels without demonstrable embolism. All the other tissues examined were essentially normal.

It was estimated after careful examination that an amount of blood in excess of 1200 c.c.

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had been lost into the mediastinum and pleural cavities, and at the site of the various fractures and soft-parts injuries.

Fig. 1. Necropsy specimen showing rupture of aorta with small thrombus at one end.

DISCUSSION

In this case of ruptured aorta and multiple fractures, the traumatic shock syndrome seems adequately explained by the pathology found at autopsy, i.e., reduced circulatory blood volume, fat embolism, and mediastinal tamponade. It is therefore unnecessary to assume the liberation and absorption of toxic substances from the damaged tissues. In the absence of a careful and complete necropsy, however, the actual causes of death would have been unrecognized, and death ascribed to "traumatic shock."

This case therefore illustrates very well the fact that adequate anatomical cause for the "shock syndrome" may be found by careful search, in many or all of the cases in which it occurs.

The mechanism of the rupture of the aorta is not clear; it may have resulted from a simple crushing of the chest, or, which seems more likely, by indirect hydrostatic pressure.

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HERPES ZOSTER

AS A DIFFERENTIAL DIAGNOSIS IN SURGICAL CONDITIONS OF THE ABDOMEN AND KIDNEYS

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WHEN a patient is seen with a complaint of acute right lower quadrant pain, with slight fever and tenderness in the region of McBurney's point, it is logical to think that acute appendicitis is the diagnosis. Likewise, if the symptoms localize over the gall bladder or along the course of the ureter, one cannot be blamed for considering the most common and logical diagnosis first. Nevertheless, if the center of trouble is in the right side of the abdomen, there are about forty different conditions which may be the cause of the symptoms. Most of these are ruled out entirely or in a large part either by their rarity, by the length of symptoms, or the age or sex of the patient, but where the diagnosis is not certain, the physician should be able to consider the less common conditions and weight the evidence with the thought of them definitely in mind.

The following is a description as given in one of the textbooks of the onset of herpes zoster as it may show itself in certain cases: "In many instances there is more or less pain in the region for one or several days preceding the cutaneous lesions. In some of the more extensive cases there may be in the beginning mild febrile reaction, chilliness, and a variable degree of malaise." In addition to this, vomiting and local tenderness have both been noted. These symptoms may precede by as much as a week the appearance of the eruption. If the condition is unilateral and localized ganglia are affected, there may be tenderness over the appendix, over the gall bladder, over the kidney and ureter, and under certain conditions, it may be very hard to differentiate or to avoid surgery. Cabot credits herpes zoster with being one of the commonest causes of lumbar pain. The following cases call to my attention rather strikingly the importance of the disease as a thing to be considered in making a differential diagnosis:

CASE I. Mr. F. C., thirty-two years of age, on March 14 complained of pain in the right lower quadrant. He had one brother to die of an unrecognized acute appendicitis and he was sure he also had an acute appendicitis. Study at this time showed a negative urine, no spasm, no localized tenderness, and no elevation of white count. The patient had been working right along and admitted he was more frightened than hurt. I advised him to get his bowels cleared with an enema and report if there was further trouble. On March 20 he reported again stating that the pain continued as a mild aggravation until the preceding night when it became much more severe and he was again rather badly frightened. Again there were no temperature, no leucocytosis, slight tenderness, no spasm, a negative urine and the patient was told that operation was not necessary as it was almost certainly not an appendicitis. The pain continued for two days and on the morning of March 23, the typical eruption of herpes zoster appeared. With the onset of this, the pain lessened and the patient ran a typical course without further evidence of trouble.

CASE II. Mr. W. M., forty-five years of age, reported with pain in the right upper quadrant of two days' duration. It was enough to keep him at home and to prevent his sleeping. He was nauseated but did not vomit. There was no past history of indigestion, of similar attacks or of jaundice. Here again was a patient somewhat apprehensive because of an acute gangrenous gall bladder which had necessitated operation in another member of his family. Examination showed a healthy man with indefinite tenderness in the right upper quadrant. There was no spasm, urine was negative, and stools were negative. There was no kidney

tenderness. As it was impossible to make a diagnosis, he was kept in the hospital and watched and three days later, that is five days after the onset of the pain, he began to feel better and with the disappearance of the pain, he had the onset of a skin eruption which he thought at first might be a hot water bottle reaction but which proved to be a typical herpes zoster. This ran a normal course and he had no further pain.

Case III. Mr. W. H., forty years of age, for some time had been having indefinite trouble with digestion and somewhat vague distress in the right upper quadrant. There had been nausea but never any urinary symptoms. On July 1 the patient had pain in the back located just back of the right costovertebral angle which was suggestive of kidney tenderness. Cystoscopy and pyelography were done. The reports were normal. The patient was told that we could find no cause for his pain and he was advised to wait. The initial symptom had been on June 26. The cystoscopy was done on July 8 and on July 10 herpetic lesions appeared over the area involved. In this case the pain continued until the lesions got better and then only did he feel normal. Inasmuch as that was two years ago and there has been no recurrence, it seems certain that his pain was due to herpes although in this case it was two weeks from the onset of the pain to the time when the skin lesions appeared.

Case IV. Mr. R., a policeman, fifty-nine years of age, entered the hospital April 21. He had a two year history of bladder irritability and nocturia. Three weeks before entrance, he began to have severe pain in the left costovertebral angle. Up to the time of entrance this pain got worse and was described as sharp, stabbing, not radiating. There was difficulty in voiding; no hematuria. Examination at this time showed a moderately stout man who showed nothing abnormal in his general examination. Blood pressure was 160/100. The prostate was normal. The kidneys were not felt and there was no tenderness over them. On entrance urine examination showed no blood and no infection. He was *x*-rayed twice in an attempt to locate some shadow suggestive of urinary calculus. Cystoscopy with a pyelogram was negative but was followed by a urinary infection which bothered him for several days. He was studied with various diagnoses in mind until a note was made ten days after admission to the effect that "there have been in the left lower quadrant of the abdomen two irregular, pin-sized lesions covered with several discreet serosanguineous crusts and surrounded by a zone of erythema a quarter of an inch wide; also, on the back at a slightly higher level five or six large pin head sized pink papules. These were over the left costovertebral angle." A dermatologist was asked to see the patient and he said that he was suffering from herpes zoster. It was with this diagnosis that the patient was discharged. It is interesting to note that the cutaneous lesions were actually present but because of their atypicality, were not recognized until every other diagnosis had been studied and discarded.

I have seen one other case in consultation in which an operation for a kidney stone had been contemplated, but the correct diagnosis turned out to be herpes zoster.

With these cases in mind, it seems to me that this condition must be considered whenever there is reason to doubt the diagnosis of acute appendicitis, acute cholecystitis or renal disease.

OBSERVATIONS ON THE USE OF BACTERIAL LYSATES IN SURGICAL CASES

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INTRODUCTION

DURING the last fifteen years an immense amount of laboratory data on the bacteriophage has appeared in the literature. Most of this work has dealt with test-tube studies. The striking effects of bacteriophagy in the test tube have led to attempts toward the therapeutic use of bacteriophage in many types of infections.

Widespread clinical use of bacteriophage preparations, based mainly on the simplest test-tube studies, has resulted in considerable confusion as to the therapeutic merits of bacteriophage. Granted that all bacteriophage preparations contain the agent of transmissible lysis in various titers, it must still be realized that these preparations differ greatly in such properties as content of bacterial substance, antigenic quality of the original cultures utilized, and constituents of the broth culture medium.

We have utilized clinically bacteriophage-lysed culture vaccines,* detailed reports of which are herewith presented. These lysates contained bacterial lysed proteins resulting from bacteriophagy of young cultures of various species, as well as bacteriophage in titers ranging from 10^{-6} to 10^{-9}. In certain instances these lysates were utilized as gels, for greater ease of application.

Colo-lysate used consisted of pooled bacteriophage lysates of coli, staphylococci, streptococci, and pneumococci. Colo-jel denotes this lysate when incorporated in a water soluble gel base.

Strepto-lysate used consisted of pooled bacteriophage lysates of streptococci and staphylococci, and strepto-jel denotes this lysate in gel form.

The following cases include a high proportion of patients who were desperately ill, and can best be presented in detail. Lysate treatment was included in all, since control treatment without lysate was not started because of the good results noted in the first case in which lysate was used.

CASE I. E. B., male, aged fourteen; admitted February 17, 1931. The patient was suffering from appendicitis of seven days' duration and had had several cathartics. W.B.C. 27,500, 88 per cent polymorphonuclear leucocytes. Urine negative. T. 101°F.; P. 100; R. 28. February 18, 1931: A small right rectus incision was made directly into the abscess cavity which drained several ounces of thick, foul-smelling pus. A ruptured appendix with large well walled-off abscess was found. The wound was closed with drainage and 15 c.c. of colo-lysate left in the abscess cavity. A second instillation of 5 c.c. of colo-lysate was made February 19, 1931, through the drainage tube into the abscess cavity. There was no change in the character of the pus except that the odor became less offensive. The patient made an uneventful recovery.

CASE II. H. S., male, aged forty-five, was admitted February 26, 1932. The patient had been ill with appendicitis for twelve hours. W.B.C. 14,000, 97 per cent polymorphonuclears. Urine negative. T. 101.4°F.; P. 104; R .20. Operation February 26, 1932. Through a McBurney incision appendectomy was performed. The appendix was gangrenous and ruptured and was removed piecemeal. It was impossible to invert the stump. There was a large amount of pus free in the abdomen with extensive peritonitis. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. The patient recovered and was dismissed March 22, 1932.

CASE III. Sister S., female, aged twenty-nine, was admitted April 1, 1932. She had been

* We desire to thank the Biological Laboratories of Eli Lilly and Company for their courtesy in supplying the various lysates and jels used in this study.

ill thirty-six hours with appendicitis and had taken many cathartics. W.B.C. 10,300, 88 per cent polymorphonuclears. T. 97.6°F.; P. 110; R. 20. Operation April 2, 1932. Through a McBurney incision appendectomy was performed. The appendix was completely gangrenous and ruptured. A large amount of pus free in the abdomen with extensive peritonitis was found. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. The patient developed a pelvic abscess which was drained through a posterior colopotomy on April 16, 1932. She recovered from pneumonia in the lower lobe of the left lung and was discharged in good condition May 7, 1932.

Case IV. H. B., male, aged forty-two, was admitted April 15, 1932. The patient had been ill with appendicitis twenty-four hours. W.B.C. 15,100, 90 per cent polymorphonuclears. Urine negative. T. 99.4°F.; P. 84; R. 18. April 15 through a McBurney incision appendectomy was performed. The appendix was gangrenous and covered with inflammatory exudate and ruptured near its base, with much pus free in the abdomen. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. The patient recovered and was dismissed from the hospital May 3, 1932.

Case V. I. J., female, aged twelve, admitted August 1, 1932. She had been ill thirty-six hours with appendicitis and had taken cathartics. W.B.C. 15,200, 88 per cent polymorphonuclears. Urine negative. T. 99.8°F.; P. 100; R. 22. August 1, through a McBurney incision appendectomy was performed. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. The patient recovered and was dismissed August 12, 1932.

Case VI. B. M., female, aged thirty, was admitted September 2, 1932, as an emergency. She had been ill twenty-four hours with a preoperative diagnosis of extensive peritonitis, the cause of which was undetermined. W.B.C. 8250, 75 per cent polymorphonuclears. Urine negative. T. 100.4°F.; P. 130; R. 30. September 2 extensive drainage was established through a small low midline incision. Twenty c.c. colo-lysate were left in the abdomen. Extensive peritonitis due either to a ruptured diverticulum or ulcer of the sigmoid was found. She died of general peritonitis September 4, 1932. No autopsy was performed.

Case VII. F. L., female, aged twenty-four, was admitted September 24, 1932. She had been ill with appendicitis for five days and the condition of the patient pointed to a ruptured appendix with peritonitis. W.B.C. 5600, 67 per cent polymorphonuclears. Urine negative. T. 99.5°F.; P. 104; R. 24. October 6 through a small right rectus incision operation was performed. The appendix had ruptured and was intimately fused with the posterior wall of the cecum and mesentery of the ileum and the omentum, making a small abscess. There was extensive cellulitis of surrounding tissue. We removed the stump of the appendix and drained the appendiceal abscess. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. She recovered.

Case VIII. Miss S., female, aged twenty-one, was admitted October 20, 1932. The patient had been ill with appendicitis for thirty-six hours. W.B.C. 16,600, 94 per cent polymorphonuclears. Urine negative. T. 97°F.; P. 95; R. 20. October 20 through a McBurney incision appendectomy was performed. The appendix was gangrenous and necrotic in several areas. It was buried in dense adhesions and was ruptured during delivery. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. The convalescence was stormy, the temperature reaching 105°F. on the second day after operation, but the patient made steady progress and was dismissed November 1, 1932.

Case IX. C. H., male, aged fifty-six; was admitted November 21, 1932. The patient had been ill with appendicitis for sixty hours. W.B.C. 14,100, 92 per cent polymorphonuclears. Urine negative. T. 100.5°F.; P. 112; R. 17. November 21, through a McBurney incision appendectomy was performed. The appendix was gangrenous and perforated. A large amount of pus free in the abdomen with considerable peritonitis was found. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. He recovered and was dismissed December 5, 1932.

Case X. L. W., male, aged thirty-five, was admitted December 18, 1932. He had been ill two days with appendicitis and had taken cathartics. W.B.C. 20,500, 84 per cent polymorphonuclears. Urine negative. T. 102°F.; P. 132; R. 28. December 18 operation was performed through a McBurney incision. The appendix and cecum were both high, the appendix being retrocecal, gangrenous, and

ruptured. There was extensive peritonitis with much pus free in abdomen with no attempt at walling off. Appendectomy was performed. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. He died December 21, 1932 of pneumonia. Autopsy showed extensive bilateral bronchopneumonia. There was no evidence of peritonitis, no pus or fluid in the abdomen, and no adhesions.

Case xi. E. L. K., male, aged sixty, was admitted December 22, 1932. The patient had an attack of appendicitis two weeks previously and had symptoms of peritonitis a few days later. At the present time he has a mass in the lower right abdomen. w.b.c. 24,300, 86 per cent polymorphonuclears. Urine 1+ albumen and many pus cells. t. 100.5°f.; p. 92; r. 22; b.p. 80/48. December 22, through a McBurney incision a large appendiceal abscess was found located posterior to the cecum and extending toward the right kidney fossa. Drainage of the appendiceal abscess was established; 20 c.c. colo-lysate were left in the abscess cavity. The patient recovered and was dismissed January 11, 1933.

Case xii. V. McI., female, aged thirteen, was admitted December 8, 1932. She had been ill forty-eight hours with appendicitis. w.b.c. 28,400, 87 per cent polymorphonuclears. Urine 2+ albumen, many casts and pus cells. t. 102.2°f.; p. 118; r. 30. December 8 through a McBurney incision, operation was performed. The appendix was gangrenous and ruptured, with a large amount of pus free in the abdomen with extensive peritonitis. The appendectomy wound was closed with drainage and 20 c.c. colo-lysate were left in abdomen. She recovered and was dismissed December 22, 1932.

Case xiii. H. L., male, was admitted November 10, 1932, having been ill twenty-four hours with appendicitis. w.b.c. 15,600, 82 per cent polymorphonuclears. Urine negative. t. 98°f.; p. 68; r. 18. Operation, November 10, through a McBurney incision, showed much thin pus-like fluid in the abdomen. The appendix was gangrenous and ruptured. The appendectomy wound was closed with drainage and 20 c.c. colo-lysate were left in the abdomen. He recovered and was discharged December 8, 1932.

Case xiv. A. E., female, aged forty-six, was admitted January 24, 1933, having been ill thirty-six hours with appendicitis. w.b.c. 20,000, 88 per cent polymorphonuclears. Urine 1+ albumen and many casts. t. 101°f.; p. 104; r. 20. Operation, January 24, through a McBurney incision revealed a gangrenous ruptured appendix with extensive peritonitis. The appendectomy wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. She died January 28, 1933, of general peritonitis.

Case xv. E. S., female, aged nine, was admitted February 13, 1933. The patient had been ill sixty hours with acute appendicitis. w.b.c. 13,300, 88 per cent polymorphonuclears. Urine negative. t. 102°f.; p. 125; r. 22. Operation February 13, through a McBurney incision revealed a gangrenous and ruptured appendix. The appendectomy wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. The patient recovered and was dismissed February 26, 1933.

Case xvi. L. K., female, aged fifty-three, was admitted January 9, 1933 having been ill twenty-four hours with acute appendicitis. w.b.c. 13,400, 82 per cent polymorphonuclears. Urine negative. Blood sugar 185 mg. b.p. 234/110; t. 100.4°f.; p. 110; r. 20. This patient is a very severe diabetic with marked arterial hypertension, and is very obese, weighing approximately 250 pounds. Operation January 9, through a McBurney incision, showed a gangrenous and ruptured appendix with much pus free in the abdominal cavity. The appendectomy wound was closed with drainage and 20 c.c. colo-lysate were left in the abdomen. She recovered and was discharged January 31, 1933.

Case xvii. G. H., female, aged thirty-three, was admitted November 5, 1932. The patient, who was four months pregnant, had an incomplete abortion November 4, 1932, the cause of which was undetermined. Upon admission she was having considerable cramping, backache, and slight uterine bleeding. w.b.c. 12,200, 86 per cent polymorphonuclears. Urine negative. t. normal; p. 84; r. 20. November 5, part of the retained placenta was removed from the uterus by dull curette, and the uterus was packed. On November 6 her temperature reached 101°f. and the packing was removed. On November 7 the temperature was 101.5°f.; on November 8, 104°f., and it was septic in type. The patient had a hard chill on November 8. Her temperature continued to remain septic in type and on November 12, following a chill, the temperature rose to 106.2°f. On November 12, 1 c.c. of

strepto-lysate in 500 c.c. normal salt solution was given intravenously and 10 c.c. of strepto-jel was placed in the uterine cavity with a sterile catheter. On November 13 the highest temperature was 101.5°F. at six in the morning; it was normal at six in the evening and 100.8°F. at midnight. The strepto-lysate was repeated, as was the instillation of strepto-jel in the uterus on November 13. The patient remained temperature free until the day of dismissal on November 18, and has remained well since.

Case xviii. O. J., female, aged thirty-one, was admitted November 9, 1932. This patient had delivered a full term child three weeks previously and had been running a septic course for the past two weeks with daily chills and high fever. R.B.C. 4,000,000, hemoglobin 70 per cent; W.B.C. 12,500, 90 per cent polymorphonuclears. T. 103°F.; P. 100; R. 18. On November 14 when the patient was referred to us she was still having a high fever and chills and a foul uterine discharge. She was taken to the operating room and the uterus gently swabbed. There was no residual matter found in the uterus. Her general condition remained the same and on November 15, 10 c.c. of strepto-jel were injected into the uterus with a sterile catheter and 1 c.c. of strepto-lysate in 500 c.c. normal salt solution was given intravenously. The character of the pus following this injection became thin and watery and without odor. The highest temperature on November 16 was 99.8°F. The same treatment was given on the 16th and on the 18th the strepto-jel was injected in the uterus but none was given intravenously. The temperature was normal on the 20th and remained normal until the time of dismissal on November 24. The patient has remained well since that time.

Case xix. H. K., male, was admitted February 25, 1933, having been ill two days with appendicitis. W.B.C. 15,100, 90 per cent polymorphonuclears. Urine negative. T. 102.4°F.; R. 30. Operation, February 25, through a McBurney incision showed an appendix gangrenous and ruptured with a large amount of rather thick yellow fluid in the abdomen. The appendectomy wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. The patient recovered.

Case xx. W. F., male, aged nine, was admitted April 3, 1933, having been ill approximately thirty hours with appendicitis. He had been treated by a chiropractor. He had taken several cathartics. W.B.C. 15,000, 95 per cent polymorphonuclears. Urine negative. T. 99°F.; P. 115; R. 20. April 3, operation through a McBurney incision revealed a ruptured gangrenous appendix with many inflammatory adhesions and much brownish pus in the abdomen. Appendectomy closed with drainage and 20 c.c. colo-lysate was left in the abdomen. He recovered and was discharged April 11, 1933.

Case xxi. M. F. L., female, aged twelve, was admitted December 5, 1932. The patient was admitted suffering from peritonitis, the cause of which was not determined. She was treated medically until abscess formation had taken place and was then operated upon. W.B.C. 22,050, 92 per cent polymorphonuclears. T. 102.2°F.; P. 128; R. 40. The urine was negative except for a few pus cells and occasional finely granular casts. December 14, a low midline incision was made, with drainage of a pelvic abscess, which presented about the midline. This was a very large pelvic abscess, probably of appendiceal origin. The patient's general condition improved and she survived a bronchopneumonia. On December 19 colo-jel was injected into the abscess cavity with little or no improvement. The patient was discharged on January 4, 1933, in fair condition, but was draining an enormous amount of pus. Her course at home was very unsatisfactory until colo-jel was again used about April 1. The discharge stopped within two days and she made a remarkable recovery.

Case xxii. F. McB., male, aged twelve, was admitted April 8, 1933, having been ill forty-eight hours with appendicitis. W.B.C. 17,200, 96 per cent polymorphonuclears. Urine negative. T. 102°F.; P. 120; R. 22. Operation April 8. Appendectomy through a McBurney incision. The appendix was gangrenous and ruptured, with much pus free in the abdomen. The wound was closed with drainage and 20 c.c. colo-lysate left in the abdomen. He recovered and was discharged from the hospital April 20, 1933.

Case xxiii. M. M., male, aged seven, was admitted May 6, 1933, having been ill forty-eight hours with appendicitis. W.B.C. 16,300, 77 per cent polymorphonuclears. Urine 1+ albumen; finely granular casts. T. 101.5°F.; P. 125; R. 26. Operation May 6 through a McBurney incision, revealed an appendiceal abscess located posteriorly and near the center of the abdomen. Drainage of the appendiceal

abscess was instituted and 20 c.c. colo-lysate left in the abdomen. The patient recovered and was discharged May 26, 1933.

Case xxiv. J. S., male, aged thirty-two, was admitted May 16, 1933, having been ill four days with appendicitis. w.b.c. 10,950, 93 per cent polymorphonuclears. Urine negative. t. 101.6°f.; p. 125; r. 28. Operation was performed May 16, an appendectomy through a small right rectus incision, with a McBurney stab wound for drainage. The appendix was ruptured at the base with extensive peritonitis. Twenty cubic centimeters colo-lysate were injected through tubes four and twenty-four hours postoperatively. He had a stormy convalescence, chiefly resulting from respiratory complications and bronchial asthma and later bronchopneumonia, but recovered and was discharged June 30, 1933.

Case xxv. M. G., female, aged thirteen, was admitted May 22, 1933, having been ill twenty hours with appendicitis. w.b.c. 15,000, 90 per cent polymorphonuclears. Urine negative. t. 101°f.; p. 80; r. 15. May 22 operation through a McBurney incision revealed an appendix gangrenous and perforated, with a large amount of pus free in the abdomen. Appendectomy was performed, the wound closed with drainage and 20 c.c. colo-lysate left in the abdomen. She recovered and was discharged June 5, 1933.

Case xxvi. C. M., male, aged twenty-six, was admitted May 24, 1933. The patient three days ago after dietary indiscretion had diarrhea of moderate severity. He then began to have severe pains in the right lower abdominal quadrant, fecal vomiting, abdominal distention, and obstipation. Appendectomy for a ruptured appendix had been performed nine years ago. A diagnosis of intestinal obstruction was made. w.b.c. 6500, polymorphonuclears 78 per cent. Urine negative. t. 100°f.; p. 80; r. 24. May 24 through a right rectus incision, the peritoneum was opened, allowing a large quantity of gas which was free in the peritoneal cavity to escape. There was a generalized peritonitis present, the cause for which could not be found. Much thin, foul smelling pus was evacuated and 20 c.c. colo-lysate were left in the abdomen. Drainage was established and a Witzel enterostomy done. The patient recovered and was discharged June 28, 1933.

Case xxvii. I. McS., male, aged twenty-six, was admitted June 1, 1933, having been ill four days with appendicitis. w.b.c. 21,250, 81 per cent polymorphonuclears. t. 98.6°f.; p. 100; r. 34. June 1, operation revealed an appendix completely gangrenous with a generalized peritonitis. Appendectomy and drainage of the peritoneal cavity through a right rectus incision and a bilateral McBurney incision were carried out. Twenty cubic centimeters colo-lysate were injected through the drainage tubes upon the patient's return to the room and this was repeated twelve hours later and twice during the following forty-eight hours. All incisions had a clear odorless drainage after the first postoperative day. The patient recovered and was discharged from the hospital June 13, 1933.

Case xxviii. G. C., male, aged thirty-nine, was admitted June 25, 1933, having been ill forty-eight hours with appendicitis. w.b.c. 9000, 88 per cent polymorphonuclears. Urine negative. t. 101.8°f.; p. 100; r. 24. Through a McBurney incision the appendix was found to be retrocecal, gangrenous and ruptured. The tissues at the base of the appendix would not permit of purse-string inversion of the stump of the appendix. Appendectomy was performed, the wound closed with drainage; and 20 c.c. colo-lysate left in the abdomen. He recovered and was discharged July 16, 1933.

Case xxix. F. E. T., male, aged fifty-five, was admitted June 29, 1933. He had an attack of appendicitis ten days previous, with considerable indigestion and abdominal distress, especially in the right side. Admittance temperature 98.8°f.; p. 84. w.b.c. 16,100, 91 per cent polymorphonuclears. Urine: specific gravity 1.026, × pus, occasional blood cell, 0.18 sugar. A small right rectus incision revealed a walled-off retrocecal appendiceal abscess. This was drained through a stab wound, and 20 c.c. colo-lysate injected through the drainage tube. The patient made an uneventful recovery, being discharged on the sixteenth day.

The following case is reported to illustrate the use of the lysate intravenously:

Patient C. O., male, aged fifty-four, was admitted March 25, 1931, with a history of pain in the rectum on defecation, starting one year previous. This pain became more severe until at the time of admittance it was excruciating, and there was a constant aching distress in the region of the rectum. There was a history

of increasing constipation not relieved entirely by enemas or laxatives. There had been some weight loss; but appetite and general strength were good. The patient had had a hemorrhoid operation three years previously. His history was negative for other digestive disturbances, serious illnesses, or operations. There was no history of cancer in the family. On entrance to the hospital the urine showed no variation from normal except a specific gravity of 1.004. Blood examination: hemoglobin 85 per cent; R.B.C. 4,260,000; W.B.C. 10,050; 59 per cent polymorphonuclears; 32 per cent lymphocytes; 2 per cent eosinophiles.

Three days after admittance a first-stage Lahey operation for resection of the rectum was done. The condition found was a carcinoma of the rectum on the posterior surface about 1 inch above the internal sphincter. Following this operation the patient made very satisfactory progress, the temperature never going above 100.5°F. On the seventeenth day following the operation the second stage of the Lahey operation was performed. The patient had a very stormy convalescence for the next two weeks, the temperature varying from 97.6°F. to 105°F. with many severe chills. The pulse varied from 100 to 145. The temperature then became normal for a period of two days and he was feeling much improved. The wounds were healing satisfactorily.

On the fifteenth day after the second operation the patient had a chill and his temperature went to 104.6°F. He evidently had developed a thrombophlebitis of the pelvic vessels. In spite of all treatment the temperature varied from 96°F. to 105°F. for a period of five weeks. Many days there would be two severe chills. The pulse varied from normal to 140. The patient lost much weight and was in a comatose condition most of the time. Blood count showed 13,000 to 27,000 leucocytes with as high as 98 per cent polymorphonuclear leucocytes. There was no malaria present. On the forty-first day after the second operation the temperature was still going as high as 104.5°F. with chills and a high pulse rate. The patient was losing ground rapidly.

About this time in the *Indian Medical Gazette* there appeared an article by Asheshov and his associates on the treatment of cholera in India with bacteriophage intravenously. After the matter was gone over very carefully with the Biological Laboratories of Eli Lilly and Company, a preparation of their streptostaphylo-lysate was secured for use in this case. Five cubic centimeters of this were given in 1000 c.c. of normal saline solution daily for fourteen days. The patient had no chills after this treatment was started. The highest temperature on the day after treatment was started was 100.8°F. It went to 102°F. on the fourth day of the treatment and then gradually declined to 99.4°F. on the eighth day, after which it did not go higher than 99.2°F. at any time. By the third day the patient was eating better, was mentally alert and reading the newspapers. His condition improved very rapidly and he was discharged from the hospital fifty-five days after the second operation and on the day of the fourteenth injection of the lysate. He has since gained 35 pounds in weight and has had no recurrence after eighteen months.

COMMENTS

1. All cases of peritonitis, in addition to the lysate treatment, were rigorously treated by the opium method as advocated by Dr. Alonzo Clark and revived and modified by Dr. George Crile.

2. Blood cultures were not made on the postpartum cases. They were referred patients and immediate treatment was instituted, but clinically they were cases of septicemia, possibly bacteriemia.

3. The patient in Case X, who died of pneumonia on the third postoperative day, proved by autopsy to have a clear peritoneum, there being no evidence of the extensive peritonitis present at the time of operation.

4. In our opinion the pus in lysate-treated cases became thinner and the odor less pronounced than in cases not treated with lysate.

5. In comparison with previous similar cases, we believe that the morbidity and the mortality are lessened by the use of the lysate preparations.

TETANUS*

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TETANUS, being so prevalent in most communities, is relatively rare in this vicinity. None the less, we should always be on the alert for it and we are not justified in ever omitting the use of prophylactic antitoxin when it is indicated.

The case here presented is of especial interest because of its sudden and violent onset, first symptoms occurring eighteen hours after injury, and because of recovery of patient. Most observers give the incubation period as being from two to seventy days, generally four to ten days; one writer stated that it may develop in one day, but I am able to find no case reported that symptoms occurred in less than one day. It is rather generally conceded that those cases with early onset and with the focal lesion about the head and face have a poorer prognosis.

CASE REPORT

M. R. R., a white male, aged nineteen, was in an automobile accident about 12:15 A.M. Sunday, November 13, 1932. He was thrown out of the car on the highway, striking a post and the ground with his head. He had multiple lacerations over scalp and face, some of which were deep, into the galea aponeurotica. He received medical attention elsewhere very soon after the accident, very little effort was made to cleanse the wounds and even the hair was not shaved from most of them. A few and inadequate number of sutures were in some of the wounds closing dirt and hair in with them. No antitetanic serum was given. The morning of the same day, the patient consulted us. Then the wounds were cleaned up as much as possible, hair shaved away, old sutures removed and new and more effective ones put in. It was planned to give him a prophylactic dose of tetanus antitoxin the following day.

Between 6 and 7 P.M. of the same day patient complained of not feeling well, and refused to eat solid food because of pain in his jaws; we consider this as the beginning of the disease. At 3 A.M. he was acutely ill, with nausea, vomiting and a temperature of 103°F. At 9 A.M. he was in shock, temperature 103°F., pulse weak, thready and barely perceptible, skin deeply flushed resembling scarlet fever, with marked blanching on pressure and slow return of color. He gradually became delirious and semicomatose. Heart sounds were weak and distant; there was no rigidity of the neck or of the jaws; he had a tetanic convulsion while in the *x*-ray room, no paralysis. Deep reflexes were exaggerated. An *x*-ray of the skull was negative for fracture. We were unable to get the patient to void to get a specimen, although he had voided earlier in the day; he was catheterized and no urine obtained. W.B.C. 23,450.

During the afternoon the patient became more restless and delirious; the temperature rose to 104.4°F., the pulse was weak and thready, unable to be counted. At 7 P.M. there was no rigidity of the neck. At 9 P.M. the neck was rigid enough so that one could lift the patient from bed with the hand at back of his head; the jaws were set tightly with risus sardonicus; he was extremely restless. The spinal fluid was negative. He was given 20,000 units of tetanus antitoxin intramuscularly and 10,000 units intraspinally at 10 P.M. A 2 per cent solution of phenol in saline was infiltrated into the tissues around all wounds.

At 10 A.M. the following day, November 15, 1932, the dose was repeated intraspinally and intramuscularly, and the phenol solution infiltrated about the wounds again. The temperature was 104.2°F. and the patient could open his mouth a little wider. He was still irrational. He passed some urine involuntarily during the night for the first time since the onset of the illness. At 5:30 P.M. there was a slight improvement in his appearance. The pulse was better. Tetanus antitoxin, 20,000 units, was given intramuscularly. The maximum temperature was 104.2°F.

November 16, A.M., 20,000 units were given intramuscularly. The patient was able to open his mouth better and protrude the tongue; the neck was still rigid; maximum temperature 103.4°F. He was still irrational at times but cooperative at times.

* From the Thomas-Davis Clinic, Tucson, Arizona.

November 17, A.M., 20,000 units were given intramuscularly. The patient was improving, with maximum temperature 102°F.; he was more rational, the neck less rigid, and he was taking fluids and food well.

November 18. Maximum temperature was 100°F.; he was improving. There was beginning urticaria over buttocks. No antitoxin was given.

November 19. Maximum temperature was 99.6°F. The urticaria was very annoying. The patient was rational and cooperative.

November 22. The patient was doing well, temperature ranged from 99° to 100°F. There was much purulent drainage from the wounds. Twenty thousand units of antitoxin were given to prevent relapse.

November 24. The temperature had been normal two days. There was profuse drainage from the wounds; otherwise the condition seemed good. He was allowed to go home in an ambulance.

When last seen January 12, 1933, he was completely recovered with no remaining effects.

COMMENT

The necessary and proper dosage of tetanus antitoxin as yet does not seem to be agreed upon. In this instance, the patient was so desperately ill, we did not feel that we could take any chance on giving too little of the one medicine, if any, that would save his life; hence heroic doses were used, a total of 140,000 units. The final dose of 20,000 units was given five days after the last therapeutic dose to prevent the possibility of a recurrence due to the still virulent bacilli in the original focus.

Also there seems to be some slight disagreement as to the preferable route of administration of antitoxin. Due to the faculty of tetanus toxin for attacking nerve tissue, there is little argument as to advisability of the intraspinal administration of antitoxin; furthermore most observers agree on the intramuscular route. The opposition is encountered when the subject of intravenous use of antitoxin is brought up. There are advocates for this route and equally as many who oppose it. Personally, we feel that there is not enough to be gained by this method, as opposed to the other two, to justify its use, when there are very certain hazards attending. Those who are familiar with allergic reactions and anaphylactic shock will hesitate before injecting so powerful an allergen as horse serum into a vein of a patient who he does not know positively is not sensitive to it. There seems much too much to lose and too little to gain over the safer methods to risk a procedure that is so definitely more dangerous. In other words, with two effective routes that are relatively safe, there is no justification for using a route that has not been proved to be infinitely more advantageous when it is known to be infinitely more dangerous.

The use of phenol is advocated especially by the Italians; 53 fulminating cases were reported by one author with a mortality of 30 per cent in which no antitoxin was used, but which were treated exclusively by the injection of 2 to 3 per cent phenol solution. It seems to us that this is not a wholly desirable procedure when we have so specific an agent as antitoxin at our disposal; however if there is any specificity to the action of phenol for B. tetani it does seem that the local injection of phenol solution about the wound is feasible, as it has been shown conclusively that the bacilli remain alive and virulent in tissues for long periods of time, and not infrequently give rise to recurrences of the disease. More work needs to be done on this subject. In our patient phenol was used locally in this manner and whether this procedure had any effect upon the recovery of the patient can not be said with any degree of accuracy, however we feel there is evidence enough to warrant the continuation of the policy which appears to be a valuable adjunct to our present treatment.

SUMMARY

1. A case of tetanus is reported which had its onset eighteen hours following injury, and despite its early onset, the location of the lesion, violent nature and the poor prognosis these factors indicate, the patient recovered.

2. The dosage of tetanus antitoxin, its mode of administration and phenol solution as an adjunct to the antitoxin are discussed.

OVARIAN DERMOID*

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BROOKLYN, N. Y.

THE dermoid cyst constitutes about 10 per cent of all ovarian tumors. It occurs at all ages, especially between the ages of thirty and forty years. The early growth of the tumor is rapid but after attaining a certain development the dermoid reaches its limit and may remain stationary for many years, its later course being determined by an accumulation of secretion in the accompanying cystoma or by malignant changes or other complications such as twist of the pedicle. A dermoid may migrate from the ovary to other organs. Three per cent of the dermoids become malignant and commonly lead to invasion of the peritoneum.

The solid embryonal tumors develop rapidly and are malignant from the start. They perforate the capsule, reach a large size and become adherent. They metastasize rapidly. The prognosis of a simple ovarian dermoid is favorable; however, when bilateral they are not infrequently malignant.[1]

The ovarian dermoid is a cystic tumor of lobular outline and smooth surfaced. It varies in size from a small nodule to a bulky cyst. It arises within the ovary, destroying the latter or leaving a small nodule of ovarian tissue lying upon the cyst. It may be attached to the ovary by a pedicle which may break from the torsion, leaving the tumor attached to the surrounding tissue. The dermoid usually contains hair, a sebaceous or oily material intermingling with the hair. Teeth may be embedded in a maxilla resembling a lower jaw, thyroid tissue, brain tissue and extremities have been observed in these cysts.[2]

The dermoid plug[3] which represents the embryonal anlage is an elevation covered with white skin from which arises hair. The skin corresponds to the scalp and below this with a fibrous capsule often re-enforced by bony plates is the brain. A pigmented area for the eye anlage is frequently present while nearby there are usually found bony masses with teeth. The plug may have entering it an opening lined by pink mucosa, probably of such entodermal elements as respiratory or intestinal tracts, which are usually very rudimentary.

Theories to explain the formation of dermoid cysts and teratomata of the ovary fall chiefly into four classes:

The first, that dermoids and teratomata arise through misplaced groups of well-differentiated cells in the ovary, has lost general acceptance. Bandler derived these cell groups from the region of the pronephros and the Wolffian bodies. This theory requires for its acceptance the further hypothesis of metaplasia of widely separated tissues. Thus, accordingly to Bandler[4] the teeth found in dermoid cysts are derived from epidermal papillae which have become cartilaginous. In the absence of any elements of epidermis in these teeth (they are usually well formed and of normal histologic appearance) to indicate such a transformation, such a theory seems highly improbable as do many other examples cited by Bandler.

The second theory is that of Marchand and Bonnet[5] who advanced the theory of the origin of these tumors from totipotent, misplaced blastomeres. Originally Marchand believed it impossible that a fertilized polar body could wander into the ovum, there to give rise to the neoplasm. The multiplicity of dermoids in a single individual (as many as 11 have been recorded in an individual[6]) negated this original concept.

* From the Gynecological and Pathological Depts., Beth El Hospital Read before the Brooklyn Gynecological Society, Nov. 6, 1931.

Marchand[7] then advanced his second theory, a corollary of the one advanced by Bonnet and himself. This was based on an observation of Roux[8] that in a frog larva there were found poorly differentiated misplaced embryonic cells between the germ layers. These might give rise to neoplasm. These cells have never been seen in human embryos. The further corollary was postulated that there were blastomeres which sooner or later severed their connections with their fellows, extended into the ovary or into other regions, there to manifest their totipotential character by producing tumors containing elements from all three germinal layers.

FIG. 1. External appearance of ovary, with cyst opened, showing solid embryonal tissue (arrow).

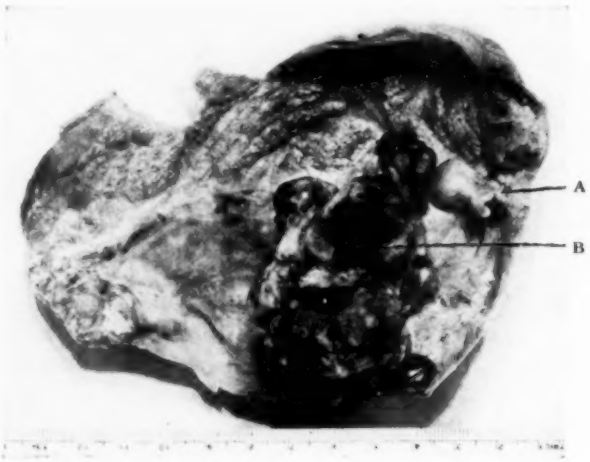

FIG. 2. Cyst opened, showing (A) extremity and (B) solid embryonal tissue containing hemorrhagic areas. Several digits of extremity have been removed for histological study.

Pfannenstiel[9] propounded the third or ovulogenetic theory for the origin of ovarian dermoids and teratomata. This was based on the fact that in early embryonic life there is a definite differentiation of the sexual from somatic blastomere (this occurs as early as the morula stage). Thereafter, these cells from which the sex organs develop assume a definite course and development, descending from their original locus high in the anlage (in the pronephric region) to assume their adult locus in the lower abdomen. Pfannenstiel believed that, under pathologic stimuli, the primordial follicles, and the oogonia of the embryonic ovary, or in early postpartum life (since these tumors preponderantly occur in the second decade and in childhood) may be stimulated to produce growths containing elements from all three germ layers. For ovarian teratomata Pfannenstiel tentatively suggested the influence of parthenogenetic cellular multiplication.

These two theories are alike in that they stress the totipotential qualities of the cells of origin of the tumor. They differ in the origin of the cells and the stimuli necessary for the cellular activation. According to the second theory, that of Marchand and Bonnet, the cells from which the tumor arises come from the same fertilized maternal ovum from which comes the carrier of the tumor. That is, the cells of the tumor and those of the carrier originated from the originally fertilized ovum and blastomeric cells of the fetus (and these may have been of somatic character which had retained or reverted to totipotential proliferating ability) misplaced in the ovary or elsewhere in the body to give rise to the teratomata. The tumor would therefore belong to the maternal generation. The only stimulus necessary for the formation of the tumor would therefore be the original fertilization.

According to Pfannenstiel's view, the tumor arises from a totipotential cell. This cell, however, is derived from an ovum or its predecessor, a primordial

follicle, oogonium, or oocyte arising from the sexual blastomeric cells of the *host*. The tumor therefore belongs to the generation of the host rather than to the maternal generation. It originates only from a sexual blastomere. For its formation the original process of fertilization does not suffice as an inciting stimulus; a second pathologic influence upon the ovule, as yet undetermined, is assumed.

A brief résumé of the arguments against the Marchand-Bonnet view is in order here. Dermoids and teratomata of the ovary occur most frequently during the active sexual period and in childhood near the onset of the menses. They are found seldom in the fetus and in children, and are extremely infrequent after the menopause unless there be indications of a tumor existing previously. If these tumors arise from somatic blastomeres, it is difficult to understand that their totipotential character should disappear at the menopause after lying latent within the ovary for so long a period. If, however, they arise from cells derived in the host from sexual blastomeres, this age frequency distribution becomes clear, the greatest number of the tumors appearing in the period of greatest sexual cell activity and being infrequent before the onset of this active period and after its total cessation.

Teratomata exhibit a very marked predilection for the ovary. They are frequently multiple. Both these findings point to a sexual cell origin. Bonnet explained these facts by assuming that the tumors arose from the urogenital anlage. This is of wide magnitude in the embryo. Multiple cells may be misplaced. His own supporters, however, chiefly Meyer, and Askanazy[10] disclaim this portion of the theory. R. Meyer, although accepting the Marchand view, showed that the urogenital tract elements are not frequently included in multiple fashion in the ovary.

Further facts support the theory of Pfannenstiel. These tumors are frequently associated in the ovary with other normal elements which exhibit abnormal or excessively normal growth changes. Thus they are associated in a very high degree with serous or pseudomucinous cysts in the same or in the other ovary. The tumors frequently contain an excessive number of elements; as many as 300 teeth have been found in a single tumor. The extragenital cysts and supernumerary ovaries can both be explained on a common basis. The sexual blastomeric cells, misplaced in the abdomen during the descent of the organ, give rise to normal supernumerary ovaries in the absence of pathologic stimuli, to extragenital dermoids when this stimulus is present.

Finally there is the group of tumors, of which our case is probably one, in which the tumor is in reality one of the twins. In such instances, the tumor and the host arise from the same ovum or different ova of the maternal generation. Both develop, the one either more rapidly than the other or, after a time, one (the future tumor) ceases to grow and is then enveloped and overgrown by the host. In contrast to the dermoids and teratomata not originating as an overgrown twin, which, while exhibiting tridermal elements, do not contain grossly well-developed adult elements, these tumors contain such elements and differ only in degree from the fully formed fetus. They are only less fully developed than the double monster, parasitic fetus, and fetal inclusions.

The following case report emphasizes the foregoing theory.

A female child, eleven and one-half years of age, white, was admitted to the hospital on November 18, 1930, complaining of pain in the lower abdomen and in the left flank for one day. The past history is essentially negative except for the usual childhood diseases. She had a tonsillectomy at the age of five. There is no history of constipation, dysuria, frequency or hematuria. Menstruation has not as yet been established.

Present Illness: The attack started with a sticking pain, occasionally felt over the pubic region and left flank; especially the day before admission when she vomited and felt nauseous

several times. The pain increased the following day to such an extent that hospitalization was deemed imperative.

Physical examination revealed a female child about eleven years old, fairly well developed and nourished, not acutely ill. Temperature 100°F., pulse 80, respirations 20. The examination was negative until we reached the abdomen. Upon inspection an ovoid mass was visible in the lower abdomen. A mass the size of a grapefruit was palpated in that locality, slightly tender, soft and cystic, extending to the umbilicus. There was no rigidity of the abdomen. Percussion over the mass elicited a diminished resonance not entirely flat or dull. Rectally a ballotable mass was palpated more on the right side and filling the cul-de-sac and lower abdomen. The cervix seemed very small, the uterus seemed cordlike. A diagnosis of a right ovarian cyst, semisolid in consistency, probably a sarcomatous tumor, was made.

The urinary findings were negative. The blood count was: R.B.C. 3,400,000; 68 per cent hemoglobin; W.B.C. 10,000, with 66 per cent polymorphonuclears and 34 per cent small lymphocytes.

Operation: On November 19, 1930, the pain in the abdomen persisted, the child was operated upon under spinal anesthesia, 10 mg. of neocaine being injected into the third lumbar interspace. A left ovarian cyst the size of a grapefruit was found; cystic in major portions, solid with a feel of bone in other portions, with two twists of the pedicle. The tube was lengthened out over the greater portion of the circumference of the mass. No semblance of ovary was discernable except for the cystic mass. The uterus was cordlike. The appendix was much longer than normal, injected and thickened and in a state of subacute inflammation. The pedicle of the cyst was ligated and the mass excised. The appendix was ligated and removed, and the stump inverted in the usual manner with a purse-string suture.

The patient was discharged on November 30, 1930, after an uneventful postoperative course, in excellent condition with normal blood findings.

Macroscopical Description: Specimen is an irregular cystic mass 10 × 10 × 8 cm., within which firm areas are palpable. Its outer surface is smooth, flesh colored, the superficial vessels congested in a mottled manner, with numerous pinpoint sized petechiae to 3 mm. sized bluish hemorrhagic areas diffusely scattered over it.

The fallopian tube courses along the upper border of the mass. It is 6 cm. in length, outer surface is smooth, gray white, glistening, its lumen patent throughout and lined by a velvety, gray non-injected mucosa. On section, the mass consists of two distinct spaces, the larger about five times the size of the smaller and situated below, posterior and lateral to it. Both are filled with a cloudy serosanguinous fluid, totalling 200 c.c. The wall of the whole mass varies in thickness from 2–4 mm., and is fairly elastic.

The inner surface of the larger space is lined by a yellow-white smooth, glistening membrane covered in its greater portion by a scaly, glistening, silvery white material which can be separated from it with ease. A growth of fine brown hairs is present over an area 1.5 cm. in diameter on the posterosuperior wall of the space.

Projecting down and anteriorly from the lower portion of the posterior surface is a nodular mass 8 × 5 × 4 cm., in size. Its surface is smooth in its greater portion, moderately hemorrhagic and varies in consistency from cystic to cartilaginous. Numerous cysts of varying sizes, the largest 1 cm. in diameter, containing a clear, colorless gelatinous fluid, project above the surface. An occasional one has ruptured. On section, the mass presents fibrous cartilaginous, fatty and small bony areas; other portions are soft and dull brown (suggesting muscle) interspersed with areas of gray-white (suggesting brain tissue). Projecting from the posterior wall 0.3 cm. medial to the mass is an atypical distal portion of an extremity consisting of a bulbous cartilaginous proximal area 1.5 cm. in diameter and a distal area consisting of five toe-like projections, the middle second and third united in almost their entire length.

The two cavities are separated by a thin wall 2 mm. in thickness, bony in its upper and lateral portions. The smaller space is lined by a smooth, gray-red, moderately injected surface. It is filled with a nodular mass continuous with the mass in the larger space, through the separating wall, but much softer and more injected.

Appendix measures 7 cm. in length, 0.5 cm. in width, its outer surface smooth, gray-white, glistening and non-injected. On section, the wall is slightly thickened, the lumen patent throughout and lined by a smooth velvety mucosa.

Microscopic Examination: Sections through

various portions of the solid wall separating the two cavities, as well as the projections from this wall into each cavity, show a profusion of all types of histoid and irregular organoid structures, all very irregularly intermingled. Chorioid plexus epithelium, pigmented retinal tissue, cartilage, notochordal cells, bone and bone marrow (showing nucleated red cells), smooth and striated muscle, a complete cross-section of small intestine and shreds of large and small intestinal mucosa stratified squamous epithelium covering dense and loose reticular fibrous tissue, the latter containing hair and hair follicles; shreds of brain tissue composed largely of glia cells and fibers, and a few ganglionic cells, in places arranged to resemble cerebellar and cerebral cortex, a few pulmonary alveoli; a small piece of tissue resembling pancreas (including several distorted islets of Langerhans), renal tubular epithelium, a few colloid-filled thyroid alveoli, near which are a few epithelial cell nests resembling Hassell's corpuscles and surrounded by lymphocytes; these are elements found in the sections. No atypical cellular construction suggestive of malignant changes is present. All the sections are rather well vascularized and the tissues are nowhere necrotic.

Sections through the digits of the extremity show no calcification or bone formation, no marrow and no epiphyseal line. Sections through the distal end of the extremity show a very narrow provisional zone of calcification. No bone marrow or bone is present. Sections of the tube and appendix show no histologic changes.

Diagnosis: Teratoma (solid and cystic) left ovary.

Note: Their profusion of tissues, their atypical appearance, and the well formed extremity make it probable that this is a case of twins, the one surrounding and overgrowing the other (the teratoma).

Other instances of such a tumor may be cited:

T. Y. Pye-Smith[11] reported the removal of a dermoid cyst from the lesser sac of the omentum of an infant twelve months old. The tumor was the size of a child's head. It contained, besides hair, a piece of bone similar to an os innominatum 1½ inches long and ½ inch wide, two feet 1½ inches long, covered with skin showing a heel, a sole, five toes on one foot and six toes on the other with rudimentary nails.

K. Maydle[12] found in a young man between the leaves of the mesentery a dermoid cyst which contained a portion of a fetus with a well-developed trunk and a lower extremity.

Robert Meyer[13] reported 4 cases, in one of which he found a head, in the second two lower extremities, in the third one lower extremity and in the fourth an upper extremity.

C. E. Shattuck[14] suggested that an embryoma may result from the fertilization of one of the primordial ova in the ovary of the developing embryo so that the embryo gives rise to a second imperfect individual whose origin is not synchronous with but of a later date than itself. This is called epiembryogenesis. In substantiation of his theory he removed an ovarian tumor from a single woman thirty-three years of age. It contained a pelvic girdle, and two lower extremities. Between the two limbs were two labia. The skin over the front of the labia had long pale hairs sprouting therefrom. A trunk with a blind coil of intestine and a spinal column holding the pelvic girdle were present. He called this specimen acephalous ovarian embryoma.

Our case is of special interest because it does not emphasize the primordial ovum theory which is today supposed to be commonly accepted by embryological authorities as this tumor was found in a child eleven and one-half years of age. It cannot strengthen the epiblastic theory because of the endodermal derivatives found therein. The only theory we could possibly class this case under would be the theory of twin fertilization, the one surrounding and overgrowing the other.

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[For Remainder of References see p. 355.]

VULVECTOMY FOR LEUCOPLAKIA AND PAGET'S DISEASE*

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THIS case is reported because it demonstrates both leucoplakia and Paget's disease of the vulva; two distinct skin diseases which though differing pathologically are similar to one another in many respects. Both disorders most frequently occur after the menopause in the latter stages of life, i.e., from forty to sixty, are resistant to all forms of local treatment, and are frequently followed by carcinomatous changes.

Leucoplakia is a specific, progressive, chronic infection of the epidermis and corium, characterized at first by hypertrophy and hyperplasia of the epidermis with edema and marked round cell infiltration of the corium. Later there is marked atrophy of the epidermis with an increase in the collagen fibers and a diminution of the elastic tissue content of the corium. In the beginning the lesion manifests itself grossly as a rounded, oval or irregularly shaped thick white patch which frequently fissures; later the epidermis becomes thin and the underlying tissues become thick and contracted. When the vulva is involved the later stage manifests itself with complete or partial atrophy of the labia minora with marked contraction of the vulvovaginal orifice. This unique picture occurring only in the region of the vulva was referred to by Breisky in 1869 as kraurosis vulvae. Graves and Smith feel that leucoplakia is an early stage of kraurosis vulvae, hence use the latter synonym to cover both aspects of the disease.

In 1847 Paget first described the disease bearing his name. At that time his description referred only to involvement of the female breast. It has been noted since then that the disease does occur in males and may involve other areas such as the axilla, umbilicus, abdominal wall, penis, scrotum and vulva. The lesion occurs in the main in individuals between the fourth and sixth decades of life and is characterized as a chronic progressive disease of the skin, grossly appearing as a sharply circumscribed eczematous area exuding a slight amount of viscid fluid with more or less surface crusting. The lesion is firm in consistency, and with time the disease spreads, involving extensive areas, subsequently ulcerating or fissuring and finally terminating in carcinoma.

Mrs. M. T. aged seventy-six, born in Ireland, was admitted to the gynecological department at the Long Island College Hospital on February 1, 1932 complaining of "falling of the womb" and "itching about the vulva." Her family history was negative. At the age of thirty-eight, the patient had an attack of rheumatism which recurred three years ago. In 1915 she had a suspension of the uterus at the St. Mary's Hospital. The menopause occurred at the age of forty-five with no bleeding nor vaginal discharge since. Married for forty-three years, gravida vii; para vi; six full term pregnancies; five were spontaneous deliveries, while her last labor terminated in a forceps delivery. Fifty years ago she had a spontaneous abortion at the tenth week with no immediate complications. Her tracts are negative save for a moderate frequency of urination during the day.

Chief Complaint: The mass protruding through the vaginal orifice has been present a great many years. It is especially marked when the patient is up and about and is aggravated on straining or coughing. Since this vaginal mass has been present; the patient experiences a soreness with a marked pruritus about the vulva and at times the latter is so intense as to be unbearable.

The general *physical examination* was negative save for a well-healed midline scar from her previous laparotomy. Pelvic examination revealed the external genitalia to be normal.

* From the Dept. of Obstetrics and Gynecology, Long Island College of Medicine.

There was a lacerated pelvic floor with a massive cystocele; the vaginal mucosa presented marked senile vaginitis. The cervix protruded through the introitus for 3–4 cm. and presented multiple old lacerations which were fairly well healed. In the region of the external os was a papillary erosion 1 cm. in diameter, from which two small polyps protruded. A moderate amount of mucopus exuded from the cervix. The uterus was small, symmetrical in outline, completely prolapsed and freely mobile. Both adnexae and parametria were negative.

Fig. 1. Photograph of gross specimen showing labia minora and majora with clitoris and diffuse involvement of left side by leucoplakia.

Diagnosis: Complete prolapse of the uterus, cervical erosion with polyps, marked cystorectocele.

Laboratory Data: Blood pressure 154/90, R.B.C. 3,390,000, hemoglobin 77 per cent, W.B.C. 8600, polymorphonuclears 72 per cent, small lymphocytes 20 per cent, large lymphocytes 6 per cent, transitionals 1 per cent. The urine showed a faint trace of albumin and a few granular casts. Sedimentation time 93 min. Blood Wassermann reaction negative.

On February 4, 1932 a *biopsy* of the cervix was done which was diagnosed in the gynecological laboratory as cervical polyps with marked hyperplasia of the lining epithelium with secondary injection. No microscopic evidence of malignancy was present.

Operation: On February 9, 1932 the cervix was cauterized and a high perineorrhaphy was done under local anesthesia.

The *postoperative course* was marred by an aggravation of the pruritus and the vulva appeared red and edematous. Some relief was obtained by local applications of boric acid compresses.

Fig. 2. Photomicrograph illustrating hypertrophic phase showing marked thickness of epidermis and dense round cell infiltration present in subjacent corium.

On February 27, the patient was discharged from the hospital. The findings then read as follows: primary union of the perineum with good muscle support. Cervix is healing and is high in the vault. The redness about the vulva has diminished markedly in intensity.

From March 10, 1932 until September 15, the patient attended the gynecological clinic, still complaining of an intense pruritus about the vulva. Numerous antipruritic ointments were used in an attempt to relieve her symptoms to no avail. On April 25, May 2, 9 and 16, deep *x*-ray exposures were given to the vulva and perineal regions; each treatment was as follows: 190 kv., 4 ma. of current, 50 cm. focal distance, filtration 5 mm. of copper, 1 mm. of aluminum, time of exposure 18 min., total dosage 205 radium units. No subsequent improvement resulted in the treatments.

Readmission: She was readmitted to the hospital on September 21, 1932 at which time her general physical examination and laboratory data were similar to those of her previous admission except for the vulva which revealed the presence of two small firm white patches

0.5 to 2.5 cm. in diameter to the left of the labia minora. The overlying skin was thin and attenuated. To the left of the labia majora was an

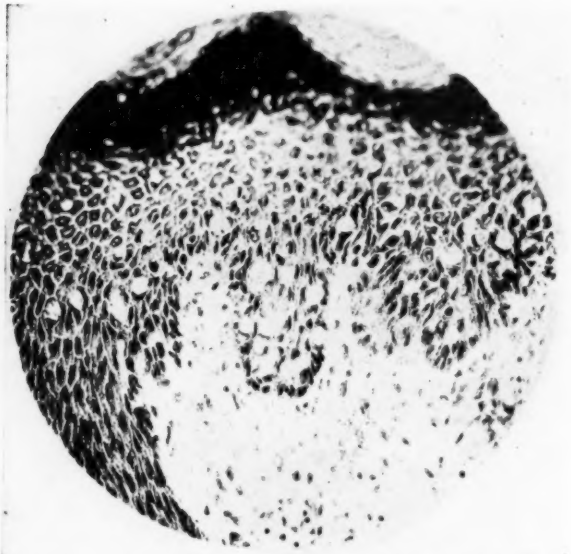

Fig. 3. High power photomicrograph of Figure 2, illustrating large polyhedral shaped cells containing a granular cytoplasm with an eccentric nucleus. These cells are the characteristic cells found in Paget's disease.

area 3 cm. in diameter which had a corrugated surface, was firm in consistency and white in color and a diagnosis of leucoplakia of the vulva was made.

On September 24 a *vulvectomy* under spinal anesthesia was done.

Her *postoperative course* was uneventful and she was discharged from the hospital on October 15, 1932, no longer complaining of pruritus, with the wound completely healed save for an area about 0.5 cm. in diameter at the summit of the incision which was granulating in and which has completely healed since, with no recurrence of her symptoms to date.

The report from the pathological laboratory is as follows: Grossly (Fig. 1) the specimen consists of labia minora and majora, the clitoris and the contiguous skin area. The excision has extended 3 cm. posteriorly to the fourchette, 8 cm. on the left and 4.5 cm. on the right. The skin on the left is triangular in outline with the apex directed to the groin. In this area the skin is corrugated due to multiple firm elevations varying in size from 5 mm. to the largest which measures 20 × 35 mm. The integument is indurated and on cross section the epidermis shows sharply defined large epithelial pegs extending into a compact and sclerotic corium. In other areas the integument is thin, soft, smooth and atrophic.

Both the hypertrophic and the atrophic

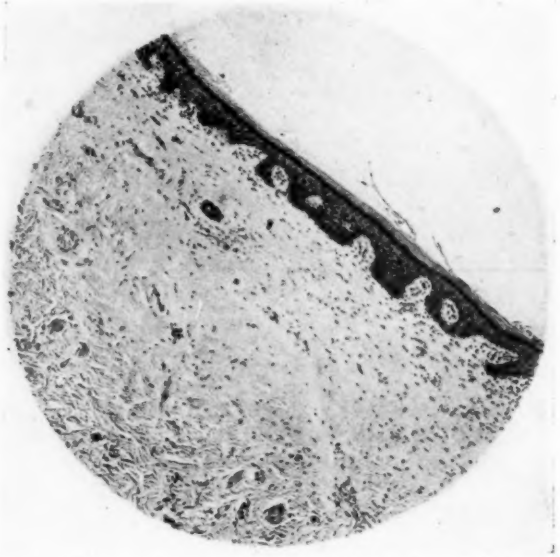

Fig. 4. Photomicrograph of atrophic phase of leucoplakia showing marked atrophy of epidermis with diminution of round cells in corium and increased amount of collagen fibers.

phases of leucoplakia are shown microscopically. In the former (Figs. 2 and 3) there is a broad zone of keratin adherent to the surface (hyperkeratosis); the prickle cell layers and basal zone show marked hyperplasia resulting in the formation of large epithelial pegs (acanthosis) that extend into the underlying stroma. The histology in the various pegs is similar. The prickle cells are hypertrophic, typically pavement or flattened in type. Focally central keratin pearls are noted. At the basal portion of the pegs atrophic changes are noted where the cells are large, oval in outline, containing a vacuolated cytoplasm which stains faintly and is finely granular. The degenerating nucleus is small, pyknotic and displaced toward the cell membrane (Paget's cells). The connective tissue immediately surrounding the epithelial pegs is edematous and contains moderate numbers of small round cells. In another section (Fig. 4) the atrophic phase is shown. Here the zone of keratin presents and is thick while the epithelial layer is attenuated, composed of five to eight layers of cells with marked flattening of the papillae which are retained only in some areas. The corium is densely compact with an occasional round cell noted.

Diagnosis: (1) Leucoplakia (the hypertrophic and atrophic phases). (2) Paget's disease.

[Concluded on p. 357.]

GANGRENE OF LOWER UTERINE SEGMENT IN OBSTRUCTED LABOR*

E. M. LAZARD, M.D., F.A.C.S.

LOS ANGELES, CALIF.

GANGRENE of the uterus is a comparatively rare condition, there being only a few cases on record. Gangrene as a result of obstructed labor is almost unknown to literature. Dunlap in an article on gangrene and necrosis of the uterus[1] reports 3 cases of his own and reviews 9 other cases reported, up to the time of his paper. Of the 12 cases reviewed by Dunlap, only one occurred as an immediate complication of labor (Case VII, Dr. Phillips). It was a transverse presentation in which attempts at correction failed, the patient dying undelivered, and gangrene of the placenta and major portion of uterus was found at autopsy. One case (number XII; Dr. Weinzier, Berlin) was that of a patient, gravida I, with a contracted pelvis, who had a forceps delivery, developed peritonitis on the tenth day, and laparotomy showed "gangrene of the uterus, which lay entirely detached below the serosa. The uterus was a dark green, sponge-like mass of gangrene, with several openings in its wall. It was removed without loss of blood." The result was not reported. The other cases of gangrene of the uterus were either not connected with pregnancy or followed abortion and sepsis.

Hughes[2] reports a case of gas gangrene of the uterus following failure of forceps delivery. In his case, the patient had been in labor for two days and a forceps attempt had been made before the patient was admitted to the hospital. The findings on admission were "vagina, extremely lacerated, cervix thick and lacerated, one half dilated and not taken up." Sixteen and one half hours after admission, the head was engaged, and 3 minims of pituitrin were given and repeated in forty minutes; forty minutes after the last dose, the uterus ruptured and at operation the uterine musculature was found to be distended with gas and gangrenous. Death occurred five hours later.

Phaneuf[3] reports a case of gangrene of a puerperal inverted uterus; abdominal hysterectomy resulted in recovery of the patient. The possibility of a condition such as Phaneuf had in his case was mentioned many years ago by Olshausen and Veit[4] who in speaking of acute inversion said, "if the os contracts firmly, strangulation of the uterine body, or in the presence of infection, gangrene may occur."

In discussing gangrene of the puerperal uterus, Williams[5] said; "Under the designation metritis desiccans, Garrigues describes a variety of severe puerperal infection, in which, not only the endometrium, but also varying amounts of muscularis undergoes necrosis, and is expelled in large shreds or even as a cast of the interior of the uterus. As Schmidlechner suggests, it should be described as a gangrene of the uterus."

Church[6] reports a case of generalized gas gangrene as a result of an infected obstructed labor.

In a search of the literature of gangrene of the uterus, the only cases which I could find, in which the condition occurred during labor as a result of obstruction of the delivery, were the one referred to above by Dunlap (Case VII, Dr. Phillips) in which the patient died undelivered and the condition was discovered at autopsy, and the case of Hughes[2] which was the result of infection with the gas bacillus.

The case which I wish to report was as follows:

The patient, a Japanese woman, was admitted to my service at the Los Angeles General

* Read before the Meeting of the Los Angeles Obstetrical Society February 14, 1933.

Hospital at 4 P.M., December 1, 1932. She was thirty-nine years of age, gravida IX, said to have had eight full term pregnancies with

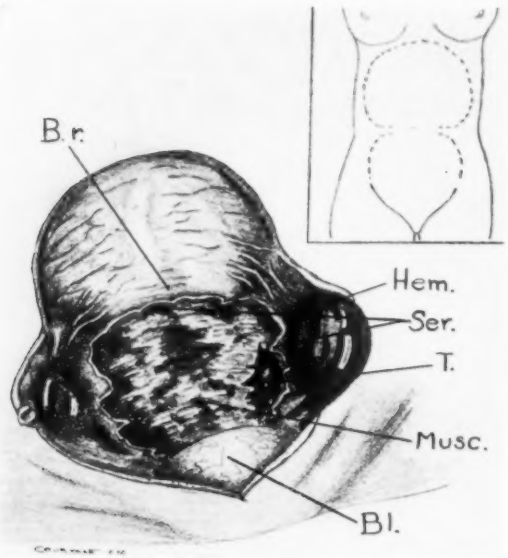

FIG. 1. B.r., Bandl's contraction ring. Hem., retroperitoneal hemorrhage. Ser., torn edge of serosa. T., longitudinal necrotic laceration of uterus. Musc., gangrenous musculature of lower uterine segment. Bl., bladder.

spontaneous deliveries at term. She was at term, and labor was said to have begun at 1 A.M. (fifteen hours before admission). The membranes were said to have ruptured at 8 A.M. She had been under the care of a Japanese midwife. On admission, the patient appeared dehydrated, pulse 145, temperature 99.6°F. The uterus reached up to the xiphoid with a definite contraction ring in the upper third of the fundus.

When I saw the patient at 6:15 P.M. my findings were: "Uterine tumor forms an irregular mass extending up to lower ribs on right side with a transverse ridge at level of umbilicus forming an hour glass uterus; fetal heart tones 136, good quality. Rectal examination: entire bony pelvis can be palpated through rectum; promontory easily reached; generally contracted pelvis; head presenting; markedly molded and large caput at ischial spines; os completely dilated. Temperature 99.6°F., pulse 145. Impression: obstructed labor, threatened uterine rupture, probable infection; patient in desperate condition. Advise: Immediate cesarean operation, preferably a Portes exteriorization operation." The patient was given 300 c.c. 25 per cent glucose, intravenously. Operation: 7:30 P.M., Porro section with suture of necrotic stump of cervix into lower angle of abdominal wound. The baby lived fifty-five minutes; the mother died at 9:20 P.M., fifty minutes after completion of the operation.

It had been my intention to do a Portes exteriorization operation because of the great probability of infection. The condition we found on opening the abdomen is well illustrated by the picture which was drawn for me by Dr. Courville, resident neurologist at the Los Angeles General Hospital, from a description of the findings given him by Dr. Krugmeier, resident obstetrician. The upper contractile portion of the uterus occupied the upper abdomen; the lower uterine segment filling the lower half of the abdominal cavity; the serous layer of the lower uterine segment had been stripped away exposing the musculature which was a dark purplish color; the broad ligament on the left side was distended and presented the same dark purplish color as the lower uterine segment. There was a longitudinal laceration of the necrotic uterine musculature on the left side which extended into the uterine cavity.

In the illustration, this laceration is pictured as being in the portion of the uterus denuded of serosa, in order to show it. It was in reality farther out under the serosa and bleeding had occurred from the uterus retroperitoneally, there being approximately a liter of clotted blood in the retroperitoneal space at autopsy.

In view of the gangrenous condition of the lower uterine segment, I decided to do a typical Porro operation, i.e. supravaginal amputation of the uterus with marsupialization of the stump of the cervix in the lower angle of the abdominal wound. A Penrose drain was placed down to the necrotic stump of the cervix.

Autopsy findings were: Pelvis is occupied by a purplish soft mass which is adherent to the surgical incision in the anterior abdominal wall. Detailed study of this mass reveals that it is composed of the bladder anteriorly, the serosal surface of which is discolored by hemorrhagic infiltration of the underlying tissue and of the lower uterine segment and rectum. The cervix is fully dilated, the walls of the lower uterine segment are thin and red. The posterior portion of the uterine stump is approximated by chronic sutures but the anterior portion is ununited and is partially adherent to the anterior abdominal wall. There is a large hematoma in the region of the stump with extension into the region of the broad liga-

ments, particularly on the left into the extraperitoneal tissues of the anterior and lateral abdominal walls. There are approximately 1½ liters of clotted blood in the extraperitoneal spaces. The lining of the bladder shows hemorrhagic discoloration in the region of the ureteral orifices.

COMMENT

This case presents several points of unusual interest. Here we have a patient who had a generally contracted flat pelvis, and who was said to have had eight full term spontaneous deliveries who presents with her ninth delivery a marked cephalopelvic disproportion and after a comparatively short labor (she had been in labor only eighteen hours, length of second stage unknown) has a high contraction ring with threatened uterine rupture. We can only surmise that the preceding babies had been smaller and thus did not cause a mechanical dystocia even though the maternal pelvis was markedly contracted.

A second point of interest was the fact that a traumatic rupture of the lower uterine segment had not occurred long before the contraction ring had reached the height of the umbilicus. I believe that this can only be explained by assuming that the musculature of this uterus was so elastic that it stretched to this unusual degree without rupturing; and lastly the cause of the gangrene of the uterine musculature. All the cases of gangrene of the uterus of which I have been able to find record, were either due to infection, especially with the gas bacillus, or to strangulation of tissue. While infection was probably present in this case, there was a temperature of 99.6°F. in the presence of shock from hemorrhage, yet it had not had time to develop sufficiently to give rise to the necrotic condition.

I believe the explanation is a strangulation of the tautly drawn muscular tissue of the lower uterine segment over the fetal body. The rupture found was not a transverse traumatic rupture as one would expect from an obstructed labor, but a necrotic longitudinal laceration. I believe the stretched-out lower uterine segment acted as a tourniquet on the venous return circulation, thus causing the gangrene to occur.

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* Continued from p. 349.

HEMORRHAGE FROM A RUPTURED CHOCOLATE CYST

CHARLES EVERETT HAINES, M.D.

NEW ROCHELLE, N. Y.

NOT long ago I found a chocolate cyst of the ovary which had ruptured and which was bleeding actively into the peritoneal cavity. This would seem to be an unusual finding and therefore of interest.

The patient was a white woman, married, thirty years of age.

History: The patient was in good health until the difficult delivery of a normal child four and a half years ago. Since then she had tired very easily, had gradually become very anemic, was unable to do any work and was so weak that she stayed in bed a large part of time.

The menstrual flow was established at the age of eleven, was regular every twenty-eight days with a profuse flow. She had never had any menorrhagia but had moderate pain just before and during the flow. On the last days of the flow the patient for many years had had sharp pains in the left lower abdomen lasting approximately forty-eight hours. Accompanying these attacks of pain there was general weakness from which she only partially recovered before the following menstrual flow. She had had several vaginal examinations by her attending physician: a soft cystic mass in the left fornix was sometimes felt by him; at other times this mass was not felt.

Examination: White woman, extremely pale. Teeth: good condition. Heart and Lungs: normal. Abdomen: retracted, soft, slightly tender at McBurney's point; no mass felt. Vagina: rectocele and cystocele of moderate size; old laceration of perineum; bilateral laceration of cervix with small erosion of posterior lip; fundus small, firm and movable without pain; moderate tenderness in right and left fornix; left ovary slightly enlarged and tender. Rectum: normal to digital palpation. Red blood count: 2,500,000 per c.mm. Hemoglobin: 40 per cent (Sahli).

Advice: The patient was advised to take a complete rest, with plenty of sunshine, a diet containing large quantities of iron and liver, and iron by hypodermic injection. Transfusions were considered but not given. She spent the winter in Bermuda where she gained in weight and strength.

I saw the patient again eight months after the first examination.

History of Intervening Months: Two weeks previously she had looked and felt well; better than for several years.

She had had two attacks of moderately severe pain in the lower abdomen about three months ago. Each of these attacks had come three days after her menstrual periods, and had lasted two or three days. During this time the patient had been up and about although she had felt weak.

Three days before I saw her for the second time she had had a sudden severe pain in the lower abdomen accompanied by a severe chill which had lasted half an hour. She was nauseated and had vomited several times. The pain was cramp-like in character, tended to be localized in the left lower quadrant of the abdomen and had persisted for three days.

Second Examination: Acutely ill, very pale, adult white woman in bed. Temperature: 101°F. by mouth. Pulse: 100 per minute. Tongue: moderately coated, somewhat dry. Heart and Lungs: normal. Abdomen: Moderately distended; no fluid wave could be made out; lower half of abdomen moderately rigid and extremely tender, especially on left; some tenderness on right. Rectum and Vagina: cervix posterior; fundus of uterus anterior and movable without pain; slight tenderness in right fornix; marked tenderness in left fornix; no mass could be made out. Urine: negative. White Blood Count: 12,000 cells per c.mm.; 93 per cent polymorphonuclears; young forms 16 per cent.

Diagnosis was uncertain, although an ovarian cyst with a twisted pedicle seemed most likely. Pregnancy and a pyosalpinx could be ruled out on the history of no coitus for six months. Acute appendicitis on the left side was considered.

Advice: Immediate laparotomy.

Operation: A suprapubic incision was made just to the right of the midline. The right rectus

muscle was split, the peritoneum exposed. The peritoneal cavity was markedly distended with blood. When the peritoneum was opened a large quantity of blood and many clots welled into the wound.

The lower abdomen was quickly explored: The uterus was small, anterior, firm, moderately movable; the right tube and ovary normal to palpation, the left tube normal to palpation. Within the left broad ligament was felt a soft cyst about 15 cm. in diameter. No other ovarian tissue on the left side could be identified. The cyst had ruptured near its base into the peritoneal cavity.

The left tube and the left broad ligament containing the cyst were removed. Blood was left within the peritoneal cavity, the abdomen was closed in layers without drainage and the patient returned to bed and immediately given 3000 c.c. of saline and glucose solution by hypodermoclysis.

The wound healed by primary union. Convalescence was uninterrupted and the patient was discharged from the hospital the sixteenth day after operation.

Follow-up: There have been three menstrual periods since operation. At the first there was moderate dysmenorrhea and a very profuse flow. At the next two there was no pain; moderate flow.

The patient is now feeling well, better than for at least five years.

Hemoglobin and red blood count are nearly normal.

Pathological Tissue Report: Specimen of: interligamentous ovarian cyst.

The specimen consists of an opened cyst. The entire mass of tissue is bluish gray in color. The cyst wall measures up to 1.5 cm. in thickness. The lining is smooth and blood stained.

Microscopic examination shows the wall of the cyst composed of dense fibrocellular connective tissue, scattered through which are areas of hemorrhage. Considerable blood pigment is present. The lining of the cyst is composed of columnar epithelial cells surrounded by connective tissue cells resembling those seen in the tunica propria of the uterus.

Pathological Diagnosis: Chocolate cyst.

CONCLUSION OF DR. GLASS'S ARTICLE*

In conclusion we can say:

1. The case illustrates both the hypertrophic and the atrophic stages of leucoplakia of the vulva.

2. Paget's disease characterized by the large epithelial cell containing a clear or finely granular cytoplasm with an eccentrically placed nucleus is also illustrated.

3. Both diseases gave rise to pruritus vulvae, which could not be controlled by any form of local medication.

4. Though only a relatively short time has elapsed since the vulvectomy the patient is free from all symptoms.

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* Continued from p. 352.

POSTPARTUM HEMORRHAGE

A CASE OF UNCONTROLLABLE BLEEDING

T. S. WELTON, M.D.

BROOKLYN, N. Y.

THE following case is reported without comment, because it is unusual.

Mrs. C. B., Italian, aged twenty-eight years, was admitted to the Greenpoint Hospital, May 24, 1933.

The last menstrual period was on October 17, 1932. She was gravida 3, para 2. Her first delivery was instrumental, the second spontaneous. She had had one spontaneous abortion three years previously. There was no history of infection or hemorrhage.

The family and past histories were negative.

The day previous to entering the hospital the patient began to have labor pains. There was no bleeding. The pains increased in severity. After she entered the hospital a physical examination was negative except that a pregnancy was diagnosed and no fetal heart could be heard. The laboratory findings were negative. The bleeding time was one and one-half minutes and the coagulation time was three minutes.

Three hours after admittance to the hospital the membranes ruptured spontaneously and a foot presented. A stillbirth fetus was delivered without difficulty. Immediately afterwards the placenta was expelled. Within a few minutes an alarming uterine hemorrhage occurred. The uterus was massaged; pituitrin administered hypodermatically, the bed placed in a high Trendelenburg position and an intravenous glucose (20 per cent) injection started. In spite of all measures the bleeding continued. The cervix was exposed and inspected and found intact. No perineal or vulvar lacerations were present. The uterus and vagina were tightly packed with gauze. The blood pressure was 80/28; pulse 90. The skin was cold and clammy. This was at 6 P.M., one-half hour following delivery. Shock treatment was continued.

At 7.15 P.M. the patient's condition was worse. There was a steady ooze of blood through the pack. A transfusion of 1000 c.c. of whole blood was given. Adrenalin, m. 3, was given every fifteen minutes.

A junior attending physician arrived at the hospital who after watching the patient for twenty minutes removed the pack and inserted a new pack into the cavity of the uterus and vagina. Following the transfusion and the repacked birth canal a slight improvement was noted. An hour later the blood pressure began to fall (80/46). The ooze of blood through the pack continued. At 9 P.M. the blood pressure was 68/40.

At 9.54 an associate attending physician responded to a call. He found the patient in profound shock, in a semi-unconscious condition, the pulse 130 and thready, and the ooze through the pack quite profuse. Thinking the junior physicians had missed something he removed the pack, inspected the cervix, vagina and vulva, discovered no cause for the bleeding, repacked the uterus and vagina, and ordered another transfusion. The patient received 650 c.c. of whole blood. The patient evidenced little response to these measures.

At 11 P.M. I saw the patient. She was unconscious. There was no systolic pressure. A steady oozing of blood came through the pack. The patient appeared to be *in extremis*. The birth canal had been packed three times and she had received 1650 c.c. of whole blood and 2250 c.c. of 20 per cent glucose solution. Therefore, we elected the last measure that seemed open to us, hysterectomy. This was done. We left both tubes and ovaries. The operating time was twenty-four minutes. During the operation another transfusion of 800 c.c. of whole blood was given. Postoperatively she was treated for shock. Within eight hours she showed definite improvement. The postoperative course was uneventful and she was dismissed from the hospital on the fourteenth day.

The pathological report was to the effect that the specimen showed the normal physiological changes of pregnancy with no evidence of retained placental tissue.

PES CAVUS OF CONGENITAL SYPHILIS*

C. W. GOFF, M.D.

HARTFORD, CONN.

A CHILD aged thirteen was admitted to The Newington Home for Crippled Children with a complaint of inability to put her heels to the floor. She was compelled to walk on her toes. This condition was becoming worse, according to her parents, causing the child to complain of a tightness in her heel cords and a clumsiness when she ran or walked. She maintained her balance by leaning forward.

Her *past history*, as given by her parents, indicated that she had always been a very nervous, high-strung child who had had the usual childhood diseases; but, according to the mother, had never had infantile paralysis. Her mother and father are living and apparently well. She had one sister who died at three years of age with pneumonia. She had one brother living aged eleven.

In the Out-Patient Department, the child was first seen and thought to have had a mild attack of infantile paralysis at some time in the past, with the resulting pes cavus and contracture of the heel cords. However, upon admitting her to the hospital and studying her more carefully, the following physical findings were noted.

Physical Examination: The child was well developed and nourished. Her face had an oldish expression with a somewhat silly smile, though not unpleasant. Her hair was scant though not markedly. The skin of her face was normal. Her pupils were irregular, the left larger than the right, and both fixed to light though reacting slightly to accommodation. Her nose was small and flat, her face broad, her mouth normal in contour with permanent teeth showing the absence of two upper central incisors. Her first molars were mulberry type, with second molars delayed, and the third absent. Her teeth were moderately carious and needed attention. The hard palate was high and sharply arched. The child spoke with a slight lisp, losing her tongue in her palatine depression. There were no signs of any paralysis or paresis of her facial muscles. Her neck was negative showing full range of motion throughout. Her chest showed a normal heart and lungs, nothing remarkable was noted. Abdominal examination was negative. The liver was not enlarged, the spleen not palpable. No areas of tenderness were noted. She did not have a pot belly. The upper extremities were normal throughout.

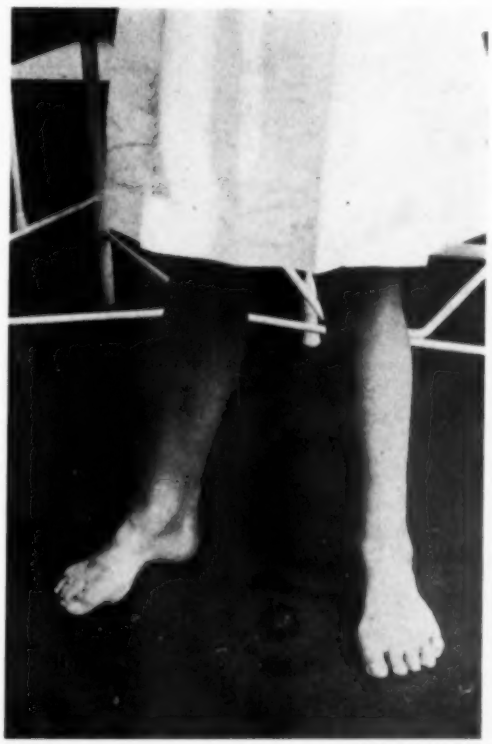

FIG. 1. Bilateral pes cavus of congenital syphilis showing short heel cords limiting dorsiflexion of feet.

The lower extremities showed no signs of atrophy. Musculature firm, with inability to dorsiflex her feet to a 90° angle. Hypertonicity of all muscles of her lower extremities existed, most marked in her hamstrings and calves. She had a typical pes cavus with a pseudo-hammertoe of the second digit of each foot. Her knee jerks were absent. No ankle clonus or Babinski sign was present. Her plantar fascia was extremely tense and her pes cavus quite fixed. When she stood in the position of soldier-at-attention, she had to rise on her toes to stand upright. She could not stand with the flat of

* From the Orthopedic Service of Dr. Robert M. Yergason and Dr. Morris M. Pike, The Newington Home for Crippled Children, Newington, Conn.

her foot on the floor and retain her balance. Her foot was correspondingly shorter than one would expect for a child of her years. Her back muscles were well developed though spastic. No hyperlordosis was noted.

Subsequent *laboratory examination* showed a four-plus Wassermann and Kahn reaction, with a spinal fluid showing a typical juvenile tabetic gold curve. This was checked on two occasions six weeks apart and did not vary. Her urine specimen was negative. In this particular instance, antiluetic treatment was instituted immediately with a diminution of spasticity of the legs and feet. The child's clumsiness became less apparent and she was able to stand with greater ease.

However, the tabetic curve did not improve and the ultimate prognosis is not good. No operative procedure was instituted because it was felt that such was not indicated prior to several intensive antiluetic courses.

This child was brought to an Out-Patient Orthopedic Clinic for a foot condition which had gone unrecognized for many years. Her foot presented the typical pes cavus of congenital syphilis. This has been described by the author,[1] with attention called to it as a helpful indicator for the detection of congenital syphilis.

This case is typical of the occasional child or young adult that is seen in most any orthopedic clinic. The author would like to call attention again to this type of foot, as a possible indicator to examining physicians of the presence of a luetic condition which might otherwise escape their notice.

[1] Goff, C. W. The pes cavus of congenital syphilis. *J. A. M. A.*, 86: 392, 1926.

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EDITORIAL

BURY THE DEAD

SEVERAL months ago the Committee on the Costs of Medical Care rendered their report. It occasioned a heated controversy. The majority of the profession sided with the minority report of this Committee. The *Journal of the American Medical Association* came out against the majority report in no uncertain terms, thus mirroring the sentiments and opinions of most of the men engaged in the actual practice of medicine.

Then came a lull. The subject became more or less of a dead issue. Many said that inasmuch as public opinion decreed against the majority report, this report would be bound up with tape and gather the dust of years in the archives. Others said: Beware! Those back of the report had power, influence and money, and although the mass of physicians consider the issue dead, nevertheless it will suddenly reappear in some frank or disguised form and by hook or crook be written into the laws.

Therefore, to those who feel the actual practice of the recommendations of the majority report of the Committee would be a disastrous blow to American Medicine, it is refreshing to read two phases, or rather aftermaths, of this subject:

Dr. J. Bentley Squire, President of the American College of Surgeons, at the Chicago meeting said in effect that practicing physicians are better equipped to plan the destinies of Medicine than a committee or group of non-practicing physicians and laymen, whose interest is at best academic.

On top of this came the annual report

of the Milbank Memorial Fund, published October 9. Disappointment over the final report of the Committee on the Costs of Medical Care is expressed, a significant statement inasmuch as the Milbank Foundation was the chief financial supporter of the survey. The Milbank report regretted the failure "to propose a comprehensive program which would solve the basic problem which it uncovered." Unfortunately the secretary of the Fund charged that much of the fault "lay with obstructionist tactics on the part of certain groups of physicians who generally control medical organizations to prevent, rather than promote, the delivery of adequate medical services to all of the people." Naturally, the majority of active physicians will disagree with this expression.

More power to the "obstructionists"! It would seem most suitable to file away this report for all time and make the entire enterprise of interest only as a part of the history of these troublesome times.

T. S. W.

Subscribers to The American Journal of Surgery *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

AMERICAN PHYSICIANS

SAMUEL BROWN

SAMUEL BROWN was born on January 30, 1769 at Augusta, Virginia. His father was the Rev. John Brown, a minister in the Presbyterian church and, also, the head of a grammar school near his home where Samuel laid the foundation of his classical education. When sixteen years old Samuel entered the seminary conducted by the Rev. James Waddell in Louisa County. Eighteen months later he entered Dickinson College, in Pennsylvania, graduating with great honor as a Bachelor of Arts.

Brown was determined to be a physician so he entered the office of his kinsman, the celebrated Dr. Humphreys of Staunton, Virginia. Several months later he left and became for a short time the private pupil of Dr. Benjamin Rush. Then he went to Edinburgh, where he worked with his customary zeal and was associated with Hosack, McDowell, Davidge and Brockenborough, who were later to become outstanding figures in American medicine. After a while at Edinburgh he travelled to the Continent, and later returned to Aberdeen where he completed his studies and received his medical degree.

Returning to America Dr. Brown began practice in the vicinity of Washington City, but inasmuch as his family had removed to the western country he joined them in 1797 at Lexington, Kentucky. In a short time he had a large practice among the best people. He was made professor of Chemistry and Theory and Practice of Medicine in Transylvania University in 1799. He held this position, no doubt a sinecure, until 1806. He was reappointed to the chair of Theory and Practice in 1819 and was a colleague of Dudley, Caldwell, Blythe, Richardson and Drake. Dr. Brown was the first medical professor of Transylvania and of the west and as such is given a place in medical history. Although he contributed to the journals of his time he did no writing of note that would perpetuate his name.

On April 18, 1800 he was made a member of the American Philosophical Society. One of his first contributions to this society was "A Description of a Cave on Crooked Creek with Remarks and Observations on Nitre and Gunpowder." He was interested in the progress of agriculture and introduced many improvements in the methods of cultivation of the soil. He was the first to suggest and perfect a method of cleansing ginseng so it would be acceptable to the Chinese market. He experimented and found that steam could be applied with advantage to the distillation of spirits.

Dr. Brown made several trips to London and the Continent and as a result was the first, or one of the first, to recommend lithotrity in this country. He was the first west of the Alleghenies, and one of the first in America, to practice vaccination. He also was the first in this country to suggest a national medical organization, although the idea did not bear fruit. It has been said Dr. Brown was a founder of the Kappa Lambda Society.

In 1825 he resigned his chair in favor of Dr. Daniel Drake. Then he retired from practice and settled on a large estate in Alabama. As a result of a stroke of apoplexy Samuel Brown died on January 12, 1830.

T. S. W.

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

THE EVOLUTION OF AMPUTATION

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INDIANAPOLIS

THE entire history of the development of surgery follows closely and is typified by the changes which have taken place in the operative procedure of amputation. Therefore if our subject is taken in its broadest sense we would certainly do it an injustice with the following brief account. It is our wish to discuss amputation from the standpoint of its technical evolution as an operation and to chronicle how our forebears met the problem with the crude methods and instruments at their disposal.

No doubt the most frequent amputation in the past has been that of the leg. All other types of amputative procedures have followed closely along the lines of this operation. It is convenient, therefore, to follow the technical changes which have taken place in the example of leg amputation. Amputations at other sites have been quite similar and have differed only as to the structures encountered in the section and not in general technical detail.

ANCIENT PERIOD

It is possible that the earliest amputations in man preceded all available records. This is suggested by some of the Egyptian and pre-Columbian Peru[14] specimens showing healed amputated extremities. However, there is reason to believe that any operative methods used in prehistoric times were no further advanced than those of the ancient Greeks. Had they been less advanced we should certainly hesitate to dignify them by the name of operation.

The ancients amputated only when gangrene was present. The types of gangrene were not differentiated and might be the result of acute or chronic vascular disease alone or in conjunction with diabetes. Other causes were trauma, "hospital gangrene," frostbite, and ergotism. The last mentioned, though rarely seen today, was a prominent cause of gangrene up to the nineteenth century.[6]

Non-gangrenous extremities were not amputated, and Hippocrates[1] advised against operation in rapidly advancing gangrene or when there was severe inflammation. As a result these patients, with rare exceptions, all died.

In amputation of an extremity, Hippocrates advocated allowing mortification to continue its course until a definite line of demarcation had formed. The dead tissue was then allowed to separate from the vital area by liquefaction of the necrotic soft parts. Hippocrates stated that he had seen complete separation in the thigh, including the lower end of the

femur, in eighty days. Similar spontaneous amputations were noted to take place in the lower leg in sixty days, and at the knee joint in twenty days. Frequently the bone and some of the necrotic soft tissue were severed to speed the process.

Hippocrates and Greek Period 400BC. Amputation through gangrene.
Celsus 25AD Amputation just above gangrene.
Xenophon 400B.C. Heliodorus and Archigenes 100AD Constricting Tapes
Guy de Chauliac 1363 Spontaneous Amputation with tight joint lacing
Guy de Chauliac - Henri de Monderville 14th Cent. Double constricting bandage.
Ambroise Paré 1552 First vessel ligation in Amputation.
Lowdham 1673 First Flap Amputation
Ravaton 1768 Double Flap after Circular Amputation.
Circular Amputation covered with Pig Bladder 16th-18th Centuries
Double Circular Amputation Latter 18th Century
Modern Open Flap Amputation
Modern Fascial Plastic Amputation.
Gritti-Stokes Amputation

Fig. 1. A few evolutionary steps in leg amputation.

The danger of stump hemorrhage was thoroughly appreciated and to a great extent obviated by this amputation through non-vital tissue. When hemorrhage did take place it was checked by the actual cautery. As already indicated, primary amputations were not attempted, with the exception of the digits, which were removed by circular incision either through the joint or bone.

The next step forward is found in the practices of Greek physicians who had migrated to Rome. They undoubtedly advanced the art of amputation, but nevertheless their practices must have resulted in a higher mortality rate than the methods of the Greeks. Their technical methods are typified by the writings of Celsus (*circa* 25 A.D.)

Celsus realized well the dangers of amputation and operated not from choice but as the only alternative. He amputated just above the upper portion of gangrene, but never through an adjacent joint (Fig. 1). At this point the main vessels to the extremity were usually thrombosed by the adjacent necrosis and the chances of fatal hemorrhage were lessened. Bleeding that did occur was stopped with a cautery. Celsus advocated a circular incision severing all soft tissue down to the bone. This was done after first drawing the skin above the incision proximally. The soft tissues were then retracted and the bone cut as high as possible with a saw. Rough bone margins were smoothed with a rasp. The skin was then allowed to come down again and partially cover the stump. A sponge wet with vinegar was applied if bleeding

Fig. 2. Sixteenth century woodcut of amputation. A pig bladder dressing is seen bound on the stump of the figure in the background. Gersdorff, 1517.[3]

persisted, and this was followed by a lint dressing.[9]

Others during the first and second centuries added slight modifications. Of these perhaps the most noteworthy was the use of tight bands of cloth applied just above and below the site of operation. The upper one of these acted as a true tourniquet. Advocates of this addition included Archigenes of Apamea (54–117 A.D.) and Heliodorus (*circa* 100 A.D.).[9] Xenophon (444–381 B.C.) also described this form of hemostasis.[21]

FIG. 3. Sixteenth century woodcut of amputation. Ryff.[11]

Other means of controlling the flow of blood included elevation of the part, cold and hot applications, dusting powders, caustics and cautery. Digital pressure over the vessels of the extremity and tight constricting dressings were also used.

Dressings consisted usually of lint or sea sponge. These were moistened with vinegar, wine, or water, and were changed periodically.

Leonides (*circa* 200 A.D.) employed an admirable technique for this early period. Using a simple circular incision, he cut the soft parts where there were no large vessels. The muscles and skin were then retracted upward with a linen cloth and the bone severed. The remainder of the tissue, including the vessels, was divided with a cautery, thus searing the vessels in the process.[2]

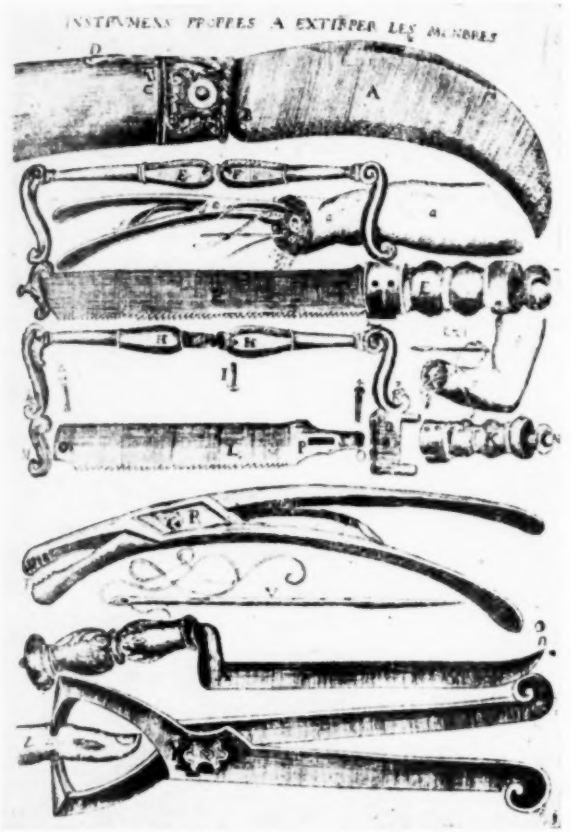

FIG. 4. Amputation instruments of Jacques Guillemeau, chirurgeon ordinary to the King of France, 1649.[16]

MIDDLE AGES

As with all sciences, the well-advanced art of amputation came to an abrupt halt in the third century. From this it was to fall into an inactive lethargy from which it did not again rise until just before the sixteenth century, when Ambroise Paré started its upward trend.

During this dormant period a few outstanding figures made contributions to amputative procedure. Paul of Aegina (625–690) followed the technique of Leonides. To Albucasis (1013–1106) is attributed

the observation of the effect of a clot in the severed vessel arresting hemorrhage. Theodoric (1205–1296) believed an operative wound should heal *per primam*. He gave his patients a soporific sponge containing opium and mandrake to deaden the pain of the operation. Henri de Mondeville (1260–1320) likewise believed in the dictum of primary healing of operative wounds. This operator used a large flat heated knife which he later applied to the stump as a cautery. He used two constricting circular bandages, one above and one below the site of amputation, which produced a fair degree of hemostasis. Guy de Chauliac (1300–1368) likewise used two hemostatic bandages. He amputated both through the mid-portion of the leg and through the joint, depending upon the site of the gangrene. Frequently a drain was inserted in the stump and hot applications added to aid healing. Guy de Chauliac also used a method of bloodless amputation. This consisted in lacing a bandage tightly at the knee joint and allowing mortification to bring about spontaneous amputation. Gersdorff (1517) advocated the use of rabbit fur and egg white as a coagulant stump dressing. Over this was placed an animal bladder which was bound tightly in place. Pierre Franco (*circa* 1500) used a tar dressing for the wound, which he felt promoted healing and acted as a hemostatic.

At the beginning of the sixteenth century the general operative procedure consisted in a simple circular incision through viable tissue. This was followed by the actual cautery to occlude the blood vessels. One exception was di Vigo (1460–1520) who amputated through the gangrenous area, thus avoiding both pain and hemorrhage. This operator then cauterized away the necrotic tissue. Botallo (1530) devised a guillotine-like apparatus to facilitate amputation. This did not prove to have any advantage over other methods then at hand, and was used principally in the amputation of digits.

It is interesting to note that all of the afore-mentioned workers together with Celsus and Galen before them were familiar with and advocated the use of the ligature in controlling hemorrhage. Though they used it in other less drastic operations, they did not use it to effect hemostasis in amputation. The time-honored use of the red hot iron had formed a tradition which was not easily broken. In fact it was not broken until 1552.

SIXTEENTH TO NINETEENTH CENTURIES

It remained for Ambroise Paré (1510–1590) with his extensive experience in war amputations to throw his weight in favor of vessel ligation. This he did with considerable doubt at first as to the virtue of the ligature and after fifteen years' experience with the merciless hot cautery and boiling oil.

Paré likewise was the first to pay particular attention in choosing an amputation site which was well above the gangrenous area and likewise suitable for a future prosthesis. A mid-leg amputation he felt was more satisfactory than one through the lower leg.

In amputations he retracted the skin upward and applied a tight hemostatic bandage above the operative site. A simple circular incision was made through the soft parts down to the bone, saving as much skin and muscle as possible in order that the bone ends might be well covered. The periosteum was stripped upward and the bone severed with a saw. Vessels were grasped in his "bec de corbin" forceps. These were ligated or transfixed securely after allowing a moderate amount of blood to escape. The wound margins were approximated with four interrupted loosely placed sutures. A gauze dressing was used which was saturated with varying combinations of vinegar, wine, ointments, oils, and rose water. This was changed at least every fourth day.

The adoption of the ligature was a slow, gradual process, and only became generally accepted years after Paré's death. In 1639 we find Woodall advocating

amputation "in the rotten part," thus avoiding hemorrhage, and giving no mortalities in the hundred cases he reported.[13]

From this time forward a great many different types of operations were tried and advocated. One of the most important was the simple flap amputation devised by Lowdham of Oxford and reported by Yonge in 1679. In this procedure Lowdham advised cutting from within outward after first severing the bones, thus leaving a muscle and skin flap which could be sutured to cover the stump (Fig. 1). This method was eclipsed by Ravaton, who in 1768 advised a double flap amputation, cutting from within outward after first doing a simple circular amputation. Vermale followed the same procedure, but omitted the preliminary circular amputation.

Priority for the flap operations must go back thirteen centuries to Oribasius (325–403), a Byzantine surgeon. This ancient operator used flaps in upper extremity amputations, making two longitudinal incisions up the arm after a circular amputation. This facilitated cutting the bones at a higher level.[11]

A double circular incision became popular in the latter half of the eighteenth century. This method was used, though not exclusively, by such authorities as Petite, Pott, Richter, Desault and Larrey. It consisted in a circular skin incision followed by an incision through the muscles and bones at a higher level, allowing ample soft tissue to cover the stump (Fig. 1).

The "funnel incision" advocated by Alanson of Liverpool in 1779 accomplished the same result by cutting the soft parts in an oblique circular manner, making the apex of the "funnel" the most proximal part of the incision. The bone was then divided at the apex and the soft tissues closed over it. During this period many of the mysterious dressings were discarded together with the pig bladder stump covering and the omnipotent actual cautery.

A typical amputation of the eighteenth century is described by Heister, a German operator. He used six assistants, whose principal duties were to hold the patient quiet. A tourniquet was placed about the extremity to guard against hemorrhage and to produce pressure on the nerves, lessening the pain. A gauze tape encircled the limb just above the incision, holding the muscles together so that they might be cut evenly with a large sickle-shaped knife. As the incision proceeded, the skin and superficial muscles were retracted upward so as to make it possible to sever the bones at a higher level. The periosteum was elevated upward and the bones cut with a saw. Vessels were ligated or closed with a transfixion suture. A dry lint dressing and a pig's bladder were used to dress the stump. The tourniquet was loosened cautiously on the following day and the bandage remained until the fourth day unless hemorrhage occurred.

In the eighteenth century the pendulum swung from the conservative use of amputation in cases of gangrene to a pernicious practice of amputating on the least provocation. A great number of extremities were sacrificed for simple fracture and gunshot wounds. This was largely the result of army surgical practice, in which it was noted that delayed amputation caused a terrific mortality.

The first half of the nineteenth century added little to the art of amputation. In general the methods of the previous century prevailed. Both circular and flap amputations were done. Sepsis of the stump was practically universal and so the type of soft tissue incision made but little difference. An osteomyelitis soon set in as a rule, and the end result was approached only after the bone end had sequestrated from the wound. In this connection it is interesting to note that Larrey, Napoleon's chief surgeon, used frequent changes of wet dressings in the treatment of infected wounds. These were kept moist with liquor sodae chlorinatae.[24]

It remained, however, for the advent of anesthesia and asepsis to pave the way to the modern treatment of amputation.

Anesthesia allowed more painstaking, careful operative methods, and did away for all time with the speed merchants who used sixty seconds at the outside for the ordinary amputation or disarticulation. Asepsis, on the other hand, allowed these carefully planned plastic operations to remain as such and not be destroyed by infection.

MODERN PERIOD

Our present-day methods present no radical change over the immediate past. They have, however, evolved into a more rational, carefully planned operation. The surgeon considers more his patient's future, and after-result, rather than merely the removal of a diseased limb. The site of the amputation is chosen so that the limb-maker can fashion a prosthesis which will be well adapted to the particular case at hand.

The prosthesis itself has evolved into more or less of a simple beneficial splint or crutch. The elaborate mechanical hands and feet of the fifteenth century have become the more practical, useful, and comfortable prostheses of today.

The present-day amputation is divided into two main types, the open and the closed plastic operation. Where infection is imminent or length of the operation a factor, the open operation is used. It consists of a circular or oblique incision with or without flaps in which the bones are divided as far as convenient above the stump end. The wound is left open to drain and heal by secondary intention. Skin traction at times is applied to aid in covering over the stump end. Frequently secondary plastic operations are necessary to produce a more satisfactory member.

The plastic amputation is used where drainage or infection is not anticipated. It consists of plastic overlapping and suture of the muscles, fascia, and skin over the bone ends. This gives an adequate protective pad to the bone, and also places the skin scar in a position where it is not apt to become tender or painful. The latter fact, however, is of little moment in the non-weight-bearing upper extremity.

With the exception of the hip and shoulder, amputations through the joints have gone into the discard as they form very poor stumps on which to fit prostheses. One amputation in the region of the knee joint which still merits its popularity is that of Gritti-Stokes. Gritti devised the procedure in 1857. His technique consisted in grafting the patella from which the articular cartilage had been removed, onto the end of the femur which had been severed at the level of the adductor tubercle. This formed an excellent weight-bearing stump but one which was rather large and bulky. Stokes obviated this objectionable feature in 1870. He advised joining the patella to the femoral shaft one inch above the adductor tubercle at a point where the femur is more nearly the size of the patella.

The treatment of the periosteum of the bone end has long been an argued question; whether to strip off the distal portion, leave it untouched, or overlay the bone end with a flap of periosteum. This problem has produced many divergent views and its solution would seem to rest entirely upon the particular case at hand.

Mention should be made of the cinematic amputation. The principle of this type of operation consists in utilizing the stump bones, tendons, or muscles in such a manner that they may activate artificial hands, fingers, hooks, etc. The complicated mechanics of this procedure can well be imagined, realizing that the motivating muscles or tendons must continue to function in their normal environment and still form some connection with a mechanical appliance. The first operation of this nature was performed by Ceci in 1900.[4] More recent workers in this field are V. Putti in Italy[17] and Sauerbruch in Germany.[18] Cinematic amputations have not by any means achieved universal success. In fact, most seem to be of little value. They may, however, be developed in the future to be quite a useful instrument.

This brief glance into the past is apt to

leave us with a feeling of safeness and superiority about our present-day amputations. But, on the other hand, our methods are still in a stage of transition, and the goal has not been reached. Surely amputation, like all surgery, is still evolving, and medical leaders of the future will criticize our failure to grasp the truths to which they then will hold.

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BOOK REVIEWS

CINQUANTE TECHNIQUES CHIRURGICALES. By Henry Delageniere. Paris, Masson et Cie, 1933.

Henry Delageniere was one of the ablest general surgeons in France. He apparently was a man who could do many things well and with a good deal of originality. He died in 1930. In the present volume his son has gathered together descriptions of a number of operations, the technique of which was improved by Dr. Delageniere. It is hard to review these, as so many fields of surgery are represented. He appears to have been particularly interested in gastrectomy, in gastroenterostomy, in a special type of excision of the rectum with an unusual method of drainage, in prostatectomy, especially for cancer of the prostate, and in an operation for uterine prolapse. He also attempted to treat epilepsy by ligating the posterior longitudinal sinus. He did everything from the removal of nasopharyngeal fibromas and cancerous tonsils to sympathectomies and operations on bones and joints. The book will be of particular interest to surgeons who are looking for technical hints.

FOOD, NUTRITION AND HEALTH. By E. V. McCollum, PH.D., SC.D. and J. Ernestine Becker, M.A., Ed. 3, Baltimore, Md., Published by the authors, 1933.

The authors state that they "have endeavored to set forth in simple language the nature of an adequate diet as the biochemist visualizes it; to make clear the effects of deprivation of individual nutrients so far as they are known; to describe the dietary properties of our more important foodstuffs; to point out the kinds of malnutrition and their extent, as they are being experienced by people in several parts of the world; to define the limits as to what can and what cannot be accomplished through diet; and to recommend a system of diet which will promote health, and which is sound from the agricultural, physiological and economic standpoint."

It must be admitted that they have done their job well. Not only the educated laymen but the average physician will derive much from the reading of this book which will make clearer the modern basis of diet than do most of the erudite biochemical treatises of the day.

It is noted that this book, published by the authors themselves, was first issued in 1925 and has enjoyed nine reprints prior to the present rewriting which has brought the material entirely up-to-date.

Into 150 pages the authors have succeeded in cramming a mine of information. The book deserves, and is sure to have, the same success in the future as it has in the past.

DAS RÖNTGENRAUMBILD. By Dr. Werner Teschendorf, and Dr. Hans Köhnle. Berlin, Urban & Schwarzenberg, 1933.

Every phase of roentgen stereoscopy is discussed at great length in this work of 173 pages. The physical groundwork for a thorough understanding of the subject is carefully laid. The theoretical portion of the work is detailed in the first 91 pages, the remainder of the book being devoted to the practical portion. The discussion includes telestereoscopy and roentgen fluoroscopy. A final chapter of 15 pages is concerned with the importance and application of roentgenstereoscopy in biology. The book is as nearly perfect as one could imagine a treatise on this highly complicated subject could be, and as a book of reference should be found in the library of every institution dealing with the roentgen rays.

APPLIED *X*-RAYS. By George L. Clark, PH.D. International Series in Physics. Ed. 2, N. Y., McGraw-Hill Book Co., Inc., 1932.

This is the second edition of a book first published in 1926. According to the Preface, "The primary motive underlying the preparation of this book is the presentation of *x*-rays as a new tool for industry." Part I is devoted to General Physics and Applications of *X*-radiation and Part II to The *X*-ray Analysis of the Ultimate Structures of Materials.

It is one of the best books on *x*-ray physics that has been published and there is much in it that will be of great value and interest to the roentgenologist and physician. There are 239 well-chosen illustrations.

ACTINOTHERAPY TECHNIQUE. An Outline of Indications and Methods for the Use of Modern Light Therapy. With Foreword by Sir Henry Gauvain, M.D. Slough, Sollux Pub. Co., 1933.

This book is divided into 3 parts: Physical Data, Alphabetical Index of Indications and Details of Technique and Supplementary List of Books and Papers.

The alphabetical list of indications is handy for quick reference and renders the book exceedingly useful. It is short and to the point and being published under the auspices of manufacturers has an extremely practical slant as they have evidently tried to answer here the questions that are continually being put to them.

The book will make a valuable addition for quick reference to the library of everyone interested in the subject.

CANCER DU COLON DROIT. By Jean Gosset, Paris, Masson et Cie, 1933.

This book represents a careful study of fifty operations on the right half of the colon. Although Gosset has done hemicolectomy in one stage he is particularly interested in the two-stage operation and describes the technique in detail. It is a very attractive book, well illustrated. There are excellent chapters on the anatomy and pathology of the colon, and what is most unusual in a book by a French writer, there is an excellent bibliography in which the work of American and German writers is properly appreciated. It is a book that will be of decided interest to the surgeon who operates frequently on the colon.

DICTIONARY OF GREEK AND LATIN COMBINING FORMS USED IN ZOOLOGICAL NAMES. By Edmund C. Jaeger. Ed. 2, Springfield, Ill., Charles C. Thomas, 1931.

This dictionary though termed "zoological" will be found of great value by physicians and students. Students of today have not the intensive Greek and Latin training that their predecessors had and they will find that this book will go a long way towards filling this gap. Most long scientific words are really self-descriptive when their roots are known. A routine use of this dictionary will help much in understanding of these words.

INTERNATIONAL CLINICS. Edited by Louis Hammam, M.D. S. 43, vol. III. Phila., J. B. Lippincott Co., 1933.

This volume of the *International Clinics*, like its immediate predecessors, is to be heartily commended. Four articles on Diseases of the Parathyroid Glands, twelve articles on General Medicine, two articles on Surgery, one article on Clinical Pathology and two articles on Recent Progress in Ophthalmology and Otolaryngology make the volume an up-to-date, compact and authoritative resume of the subjects treated. The articles on "Spondylolisthesis" by Dr. Samuel Kleinberg and "The Management of Acute Head Injuries" by Dr. B. Noland Carter will be of interest to every surgeon.

ACUTE INTESTINAL OBSTRUCTION

MONROE A. McIVER, M.D., F.A.C.S.

ELEVENTH INSTALLMENT

CONTENTS

[This Number]

Chapter		Page Vol. XXII
XXIX–XXXI.	Theories as to Cause of Death: Toxemia	374, 380, 387

[Previously Issued]

Part I: The Disease

		Vol. XIX
I.	Introduction	163
II.	General Considerations	172
III.	Varieties of Obstruction	191
IV.	Varieties of Obstruction (Continued): Bands and Membranes	365
V.	Varieties of Obstruction (Continued): Volvulus	378
VI.	Varieties of Obstruction (Continued): Intussusception	387
VII.	Varieties of Obstruction (Continued): Internal Hernias	581
		Vol. XX
VIII.	Varieties of Obstruction (Continued): Neoplasms	171
IX.	Varieties (Continued): Strangulated External Hernia	182
X.	Varieties (Continued): Occlusion of the Mesenteric Vessels	194
XI.	The Clinical and Pathological Picture: Morbid Anatomy	476
XII.	Clinical Pathological Picture (Continued): General Findings	483
XIII.	Clinical Pathological Picture (Cont.): Changes in Body Fluids	489
XIV.	Clinical Picture (Cont.): Mechanism of Cardinal Symptoms	500
XV.	Functional Obstructions	812
XVI.	Functional Obstructions (Continued): Varieties	823
XVII.	Functional Obstructions (Continued): Preventive Measures	833

Part II: Diagnosis and Treatment

		Vol. XXI
XVIII.	Diagnosis: General Considerations	145
XIX.	Diagnosis (Cont.): Special Points & Differential Diagnosis	159
XX.	Treatment: Preoperative	308
XXI–XXIII.	Treatment (Cont.): The Operation	317, 326, 472
XXIV.	Treatment (Cont.): Points in Certain Types of Obstruction	481
XXV.	Treatment (Cont.): Care of the Patient after Operation	489
XXVI.	Treatment (Cont.) Complications	493
		Vol. XXII
XXVII.	Mortality	151

Part III: The Cause of Death

XXVIII.	Experimental Methods	167

Chapter XXIX

THEORIES AS TO CAUSE OF DEATH

Many theories have been advanced to explain the clinical symptoms and death that follow intestinal obstruction.

Among the older ideas, the belief that a vasomotor reflex[1,2] was responsible for the symptom complex of obstruction received considerable attention in the latter part of the nineteenth century. The advocates of this theory were impressed by the intense pain and other signs of nervous irritation often shown by the patient, and they attributed these symptoms and the ultimate collapse to a reflex action upon the vital centers in the central nervous system resulting from injury to the nerve endings and important plexuses of the splanchnic area. The experiments of Goltz,[3,4] in which he was able to produce shock in the frog by repeated blows on the viscera, are frequently quoted in substantiation of this theory. But while severe pain sensation may adversely influence the patient's condition and may even be responsible for some of the early symptoms, there is no real evidence that it is of fundamental importance; and this theory is not taken seriously by modern students of the subject.

Another of the older theories, which must be mentioned because of its importance in the past, was the belief that a bacteriemia was responsible for the illness and death of the patient with obstruction. This view has been so conclusively disproved by McClure,[5] Hartwell and Hoguet[6] and McKenna,[7] that it does not seem necessary to review the evidence.

Turning to the more important theories advanced today to explain the symptom complex of obstruction, the belief that this disease is the result of the absorption of a toxin from the bowel will be discussed first. In spite of the lack of evidence on certain points and the contradictory nature of the evidence on others (for a comprehensive analysis and bibliography see Cooper's[8] monograph), this theory is the one most

widely held today; and although there is difference of opinion as to the nature and source of the toxin, it probably furnishes the best explanation of the cause of death in those types of obstruction where damage to the bowel wall or mucosa can be demonstrated. The accumulating evidence, however, that the type of obstruction (simple high obstruction) which for a long time was considered to furnish the most striking clinical evidence of the absorption of a toxin can be satisfactorily explained on another basis,* makes one adopt a more critical attitude toward the whole toxemia theory.

Toxemia in Obstruction

General Outline of the Problem. The conception that the symptoms and death of patients with acute intestinal obstruction might be due to the absorption of a toxic substance has been held for a long time.[9] It is a plausible theory: the fluid content of the obstructed intestine is extremely foul; and it was found early in the nineteenth century that drawing off this fluid by means of an enterostomy often saved the patient's life even though the obstruction was not relieved. Furthermore, the patient with obstruction often presents the general appearance and symptoms suggestive of one suffering from poison.

The efforts of experimenters have been directed in the main, first toward proving that the disease is caused by a toxin, and second, toward determining the chemical nature of this toxin, its source and its mode of absorption. The literature on the subject is complicated by the fact that many different experimental types of obstruction have been used and the assumption frequently made that the underlying toxemia was the same in all cases. This is clearly unwarranted; the cause of symptoms must be studied separately for the various types.

The first phase of the problem, namely proving that the disease is caused by the absorption of a toxin, appears on casual inspection to be easy. It is a simple matter to draw off the intestinal content that collects above an obstruction and to

* See May installment, p. 490*ff*.

inject it intravenously (either in the state in which it comes from the intestine or after carrying out various procedures with a view to obtaining the toxin in a purer and more concentrated form) into a normal animal. The animals receiving such injections usually die promptly* with symptoms that are said to resemble those shown by animals with actual obstruction: that is to say, the animals usually vomit, go into collapse, and die in a short while.[12–14] This type of experiment, with modifications, has been carried out innumerable times during the past thirty years; and the results obtained constitute the major direct evidence that the absorption of a toxin from the intestinal tract is responsible for the symptoms of obstruction. It is obvious that this method is crude in the extreme; and there are many assumptions in the line of argument for which direct evidence is lacking. There need be no serious question but that the fluid which accumulates above an obstruction usually contains toxic material.† A plethora of toxins have in fact been isolated and shown to be poisonous for animals when introduced in the appropriate manner. The toxicity of the fluid varies with a number of factors, the type of obstruction being an important point.[14] The salient questions are these: Are the toxins found in the obstructed loop absorbed; and, if so, are they responsible for the symptoms and death following acute obstruction?

In attempting to show the mechanism of absorption, or indeed to show in any direct way that absorption of toxin from the obstructed bowel occurs at all, grave difficulties have been encountered.

Chemical Nature of the Toxin. While most workers are agreed that the intestine, above an obstruction, contains substances which when injected intravenously into a normal animal produce toxic symptoms, there has been a wide divergence of opinion as to the nature of these toxins.

* Several observers have reported that when the Berkefeld filtrate of the contents of a strangulated loop is injected, no toxic effects are noted.[10,11]

† At times even the normal contents of the small intestine are toxic.[15]

It is not surprising, considering the complex nature of the fluid that collects above an obstruction, containing as it does innumerable bacteria and a large amount of protein material in all stages of decomposition, that half a dozen or more different types of toxins should have been isolated. Nesbitt,[16] among the earlier workers, reported the finding of choline and neurine; Murphy and Brooks[14] thought the toxic substance resembled a ptomaine. Exhaustive studies were carried out by Whipple and his co-workers[17] in order to determine the chemical nature of the toxic substance found in their closed loop experiments. They concluded that it was a primary heteroproteose, having the following characteristics: it resists autolysis and pancreatic and tryptic digestion; it is thrown out of solution by five volumes of alcohol or by half saturation with ammonium sulphate; it is readily soluble in water; it is not injured by boiling; and it is not removed by dialysis. In 1919, Dragstedt and his co-workers[18] came to the conclusion that toxic amines were formed by the action of bacteria on amino acid.

Certain workers have put forward the attractive theory that histamine* is the responsible factor in the toxemia of obstruction. Its presence, in minute concentration, was first demonstrated in 1921 by Meakins and Harrington[22] in the cecum and colon of human patients several weeks after the removal of an intestinal obstruction[23]; but after studying its absorption from the intestine and balancing all the evidence they decided that it was probably not an active agent in causing intestinal intoxication. More positive results were obtained by Gerard[24] in 1922. He found that histamine was present in the fluid from seven out of eight intestinal loops and that the contents of the one loop that did not show histamine did not

* Dale[19,20] and his co-workers, in extensive studies of the pharmacological action of this drug, have noted particularly its depressor action on the systemic blood pressure, due to its effect on the capillaries. Cannon[21] and others have considered that some histamine-like substance is the cause of traumatic shock. Since shock-like symptoms and, in the terminal stage, a low blood pressure, are met with in intestinal obstruction, the idea that histamine might be a common agent in both traumatic shock and acute obstruction aroused considerable interest.

produce toxic symptoms on injection. This author also showed the presence of a combined histamine derivative in obstructed loop contents. Extensive studies undertaken by Wangensteen and Loucks,[25] however, failed to show any absorption of histamine from a simple obstruction of the small intestine of two days' standing; they considered that absorption of histamine was slight even from strangulated but still viable segments.

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* Continued from the October installment, p. 179.

Chapter XXX

THEORIES AS TO CAUSE OF DEATH (Continued)

Toxemia in Obstruction (Continued)

Source of Toxin. *Toxins Derived from Food Substances.* The idea that the symptoms of the illness accompanying obstruction are due to toxins formed by the action of bacteria or digestive ferments on food is an old one and is now of merely historical interest. It is closely related to the more general idea of intoxication by intestinal products formed as a result of constipation or "intestinal stasis," the so-called "auto-intoxication"; and in the older literature considerable emphasis was laid on the increased amounts of indican in the urine, and on other evidences of intestinal putrefaction. The toxins formed in this way which have been considered responsible for the symptoms of intestinal obstruction are varied: among them may be mentioned peptone and other substances formed in the course of protein digestion; phenol, endole, and skatole; putrescine; cadaverine; a large number of organic acids; ptomaines; and, finally, neurine and choline, which are derived from lecithin. These latter substances, which are highly toxic, were isolated by Nesbitt[1] from the contents of the obstructed intestine after feeding egg-yolk.

Bokai's name[2] should also be mentioned in connection with early studies on toxins derived from food. This author stressed the rôle of organic acids as irritants in bringing about inflammation and increasing peristalsis.

That toxic substances of the types already mentioned may at times be extracted from intestinal contents is well recognized. Food, however, certainly does not play any important part as a source of the toxin in obstruction, for it has been shown that if the animals are starved for a considerable time before the production of the obstruction the course and duration of the disease are not essentially changed.[3]

Digestive Ferments as a Source of Toxin. Bile and Pancreatic Juice. The bile[4] and pancreatic juice[5,6] have been considered to be possibly responsible for the intoxication of obstruction, either by absorption into the blood stream under the abnormal conditions existing, or by producing through their digestive action in the obstructed intestine substances which are absorbed and which then give rise to the symptoms. The pancreatic juice, because of its powerful protein and fat-splitting ferments, has received special attention. Sweet[5] in his earlier work thought that the pancreatic ferments were chiefly responsible for the toxemia of obstruction and that the symptoms were comparable to those shown by a patient with acute pancreatitis; he believed that both diseases were due to the same toxin produced by the same digestive ferment. He later[7] modified this view because he thought that he could still demonstrate a toxin although the pancreatic juice was excluded. (See also experiments of McClure.[8]) Draper[9] likewise altered his view that bile was a toxic factor in obstruction, for he was able to show that the exclusion of bile from the obstructed intestine did not alter the picture.

Formation of a Toxin in the Duodenal Mucosa. The belief that the absorption of a toxic substance elaborated in the duodenal mucosa is responsible for the symptoms of obstruction occupies a large place in the literature. The first advocates of this theory, Roger and Garnier,[10,11] and Draper,[9] used simple high obstruction (see Fig. 57*) in their experimental work; and they attributed the death of the animal to an absorption of a toxin.† In the theories of both Roger[11] and Draper[9] there was

* This appeared in the October installment, p. 169.

† In the work of these investigators there was the belief that a toxin was always present in the duodenum, but that under normal conditions it was neutralized and rendered harmless. Draper considered that the poison of the duodenum was normally neutralized by the secretions of the jejunum. (See also Ref. 12.) He was led to this belief by the fact that when he placed the obstruction a short way down the jejunum the animals lived longer than when the obstruction was located in the duodenum. In the light of modern knowledge, this could be explained more simply by assuming that there is not such a rapid loss of the digestive secretions in the lower obstruction.

the underlying idea that the disease they produced in animals resembled a deficiency disease.* Draper was very close to the truth when he pointed out that the symptoms shown by his animals (muscular tremors, spasticity of the flexor muscles, high pulse rate, etc.) "peculiarly resembled those of parathyropriva"; evidently his animals showed symptoms of gastric tetany due to the loss of chlorides in the vomitus and consequent alkalosis. But this was before the work of MacCallum et al.[14] had shown the true nature of gastric tetany. It would seem that the result of the early experiments with simple obstructions could be explained much more satisfactorily by the theory that death was due to the loss of water with the sodium and chloride ions than by the elaborate and complicated ideas centering about the existence of a toxic secretion of the duodenum. The experiments of Murphy and Brooks,[15] and Dragstedt et al.[16] have furnished convincing evidence that the normal secretion of the duodenum is not toxic.

Turning from these experiments, in which a simple obstruction of the intestine was produced, to those in which a different type of experimental procedure was employed, the experiments of Whipple and co-workers will be considered.

In 1912, Stone, Bernheim and Whipple[17] published the first of a series of papers that extended over a number of years, in which they developed clearly the idea that under conditions of obstruction the mucosa of the duodenum develops a toxic secretion. They were able to isolate a toxin from the contents of an obstructed duodenal loop, and carried out extensive studies to determine its biological properties and chemical nature. In order to understand the significance of their work we must consider these experiments in some detail, for their method represents an important and new type of experiment

* If instead of a deficiency of some complex organic substance a deficiency of water and sodium and chloride ions be assumed, simple high obstruction is a deficiency disease; but the ideas current about 1910,[13] that the duodenum produced a specific secretion necessary for the life of the animal, have been thoroughly disproved.

that has since been used extensively in attempting to solve the problem of the cause of death in intestinal obstruction.

These workers were engaged in isolating a loop of duodenum in order to obtain its secretion unmixed with pancreatic juice. They divided the duodenum just distal to the entrance of the pancreatic duct and again at the beginning of the jejunum. They re-established the continuity of the intestinal tract by an end-to-end anastomosis and delayed opening the isolated loop for twenty-four hours in order to avoid sepsis. They found that the dogs so operated upon usually died within twenty-four hours. This was the beginning of the work on closed duodenal loops. (See Fig. 59B.*)

The method that these authors used in most of their subsequent work was to place a tie just distal to the pancreatic duct and a second tie at the junction of the duodenum and jejunum; they then re-established the continuity of the gastrointestinal tract by a gastroenterostomy (see Fig. 59C†). They found that animals so prepared usually died in from twenty-four to sixty hours.[17] They at first thought that drainage of the closed loop would save the animals' lives;[17] but later[18] reported that the dogs died even though the loop was drained.‡

These authors found that the contents of the obstructed loop were highly toxic when injected into the blood stream of a normal animal.[17] They further found that they could not detect the toxin if they destroyed the mucosa of the duodenum with sodium fluoride§ before producing the obstruction;[19] and they could not demonstrate the toxin in loops from the lower ileum or colon.[20] They also found that when they constructed loops in the lower ileum the animals lived much longer and did not show the toxic picture presented by animals with the duodenal loops.[21] These facts led them to believe that the toxin was

* Figure 59 appeared in the October installment, p. 174.

† Figure 59C appeared in the October installment, p. 174.

‡ Sweet's criticism, already quoted (footnote, October installment, p. 175) is that the animals still had obstruction, through failure of the gastro-enterostomy to function.

§ The animals with the mucosa destroyed in this manner died of peritonitis and bronchopneumonia.[19]

formed in the mucosa of the duodenum. They considered that it was a proteose and that an animal could be at least partially immunized against it.[22]

The work of these authors exerted a profound influence upon the current ideas in regard to the cause of death in intestinal obstruction. On the basis merely of the experiments with simple high obstruction, as carried out by Roger, Garnier and Draper, it is questionable how wide an acceptance the theory of a toxic secretion of the duodenum would have gained; but the experiments of Whipple and his co-workers with the closed duodenal loops seemed to furnish direct evidence of the existence of such a secretion. The type of obstruction employed was supposed to simplify the situation, for the secretions of the pancreas, stomach and liver did not enter the closed loop.

As a matter of fact, this method introduced a whole new set of conditions, for no drainage back into the stomach was possible from these blind loops, and since secretion is profuse in the upper intestine, the serious factor of damage to the bowel wall from increased pressure entered into the situation. Whipple and his co-workers considered that their toxin was a secretion by the duodenal mucosa; another possibility, however, must be considered, namely that the toxin was formed by bacterial action, and while no direct evidence can be produced in favor of this view, considerable indirect evidence can be brought forward to show that this, and not a toxic secretion of the mucosa, is the correct explanation of the cause of death in the animals with closed duodenal loops. The evidence for this view will be presented in the next chapter.

In conclusion it may be said that the experiments with simple obstruction of the duodenum furnish no real evidence of a toxic secretion; and that the symptoms and death of the animals can be much more simply explained on the basis of the loss of digestive secretions.

The animals with closed duodenal loops show damage to the bowel wall from increased pressure within the loop; these animals probably die of a toxemia. This is very likely due to

the action of bacteria, and not to a toxic secretion of the duodenal mucosa.

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Chapter XXXI

THEORIES AS TO CAUSE OF DEATH (Continued)

Toxemia in Obstruction (Continued)

Source of Toxin (Continued). *Toxins Formed by Bacterial Action.* As stated in Chapter xix, the theory held by earlier workers that bacterial invasion of the peritoneal cavity and systemic circulation was responsible for the toxemia has in general been abandoned. The question that has not been settled is whether or not the action of bacteria in the lumen or wall of the intestine is responsible for the death of the animal.

All observers agree that the intestinal fluid above an obstruction contains an innumerable number and variety of bacteria. This is true for all types of obstruction; even in the upper portions of the intestinal tract, where under normal conditions the bacterial flora is sparse,[1] a rich and varied flora develops rapidly under conditions of obstruction.[2] It is a plausible theory that this profuse growth of organisms, incubated as it were in the obstructed intestine, elaborates a toxin which is absorbed into the body and produces the clinical picture of toxemia shown by patients with acute obstruction.

As has already been pointed out, it is usually an easy matter to prove that the contents of an obstructed intestine are toxic on injection into a normal animal. The difficulty that has been encountered by the advocates of the theory that bacterial action is responsible for the toxemia has been in proving that bacteria produce the toxic material found in the obstructed intestine and that this toxin is absorbed and causes the death of the animal.

As regards the responsibility of the bacteria for the production of the toxin in the loop contents, the early workers for the most part either assumed that this was so because the bacteria were so abundant and other factors such as food or digestive secretions had, they believed, been ruled out;[2] or they

carried out further experiments in order to show more directly the rôle of bacteria. Filtrates from aerobic cultures of the intestinal flora, for example, were made by Clairmont and Ranzi[3] and were considered to elicit the same toxic symptoms as those produced by an injection of the toxic material from the obstructed intestine.

In 1911, Murphy and Vincent[4] in their studies on the cause of the toxemia used a different type of obstruction: in addition to simply blocking the lumen of the bowel they occluded the mesenteric circulation in various ways. This type of obstruction has already been discussed,* so that it suffices here to say that they made it clear that interference with the circulation of the bowel wall is an important factor in the production of the symptoms of obstruction, a fact that had been recognized in the clinical field for a long time. They concluded that bacteria and endotoxins were responsible for the toxemia, because they found that when small quantities of the intestinal contents were injected intravenously into a normal animal, profound symptoms of toxemia were produced; whereas if the contents were passed through a Berkefeld filter, which removed the bacteria, the filtrate was not toxic. (See also Refs. 5 and 6.)†

In order to prove the importance of bacteria, a number of workers have attempted to produce obstructions free from bacteria: if under these conditions the animal did not become sick it seemed safe to conclude that bacteria were responsible for the symptoms shown by animals obstructed in the usual manner. The difficulty with such a type of experiment is that it is impossible to get rid of the bacteria without considerably altering the other conditions of the experiment.

Among such experiments are those of Murphy and Brooks,[7] who isolated a loop of jejunum; one end of the loop they closed,

* See October installment, p. 155.

† The fact that no soluble toxin could be demonstrated after Berkefeld filtration of the contents of strangulated intestine was one of the factors that led Wilkie[8] to discount the importance of toxemia in strangulation.

the other end was brought out as a fistula through the abdominal wall. The continuity of the intestinal tract was re-established by an end-to-end anastomosis. They reported that after a number of days the loop became sterile, cultures showing no growth. The draining end of the loop was then obstructed. The animal showed none of the symptoms that follow the ordinary obstruction of a jejunal loop. Four days later the contents were found sterile and were non-toxic on injection into another animal. When the loop contents became infected the usual symptoms of obstruction promptly followed.

Murphy and Brooks[7] also employed another method to show the rôle of the bacteria in the production of the toxemia: they produced obstructions of the gall bladder and its circulation, with and without the presence of bacteria. They showed that under ordinary conditions the circulation to the gall bladder could be obstructed to the point of complete gangrene without any ill effects; whereas if the circulation to the gall bladder were blocked and at the same time organisms obtained from an obstructed intestine were injected into the gall bladder, the animals became ill. These authors considered that this illness was comparable to the toxemia of intestinal obstruction, and the conclusion was drawn that the toxemia of intestinal obstruction was due to the action of bacteria.

More recently, Dragstedt and his co-workers[8–11] have been strong advocates of the theory that bacteria are responsible for the symptoms of intoxication. A considerable portion of the work of these authors has been directed toward disproving the theory of a toxin secreted by the duodenal mucosa, advanced by Whipple and his co-workers.[12] Dragstedt et al. have employed a method similar in general principle to that used by Murphy and Brooks,[7] in that they have attempted to produce obstructions free from bacteria. These authors[8, 10] first washed isolated loops in the lower jejunum with water and ether. When the loops were obstructed after this procedure the animals survived almost indefinitely; but it was found that the loops were not sterile. The survival of these animals was

attributed to the fact that ether acted as an astringent to the mucous membrane, cutting down secretion: if the secretion was not abundant no distention occurred, and consequently no damage was done to the mucosa. It was later shown that other astringents, such as tannic acid, had the same action, although they were not bactericidal.[10]

Dragstedt et al. used a second method[13] of eliminating the bacteria. They found that if a loop in the upper intestinal tract were isolated with its blood supply intact, and were then washed, the continuity of the intestinal tract re-established and the loop dropped back into the peritoneal cavity, while about half the animals so operated upon died of general peritonitis, the remainder lived; and when the abdominal cavity was opened after a lapse of a number of days it was found that the loop had been sterilized by the action of the peritoneal fluids. If at this time the ends of the loop were closed the animals lived almost indefinitely and death did not follow even when obstruction to the mesenteric circulation was produced. These authors considered these experiments proof that bacteria were responsible for the disease.

Type of Bacteria Responsible for the Toxemia. Since the bacterial flora of an obstructed loop is so exceedingly abundant and so diverse in type, most workers have considered it a hopeless task to hold any one organism or group of organisms responsible for the toxemia. Cannon et al.,[14] however, concluded that it was always associated with a proteolytic flora.

It is generally agreed that the normal intestinal flora includes a large number of anaerobic organisms.[5] In 1926, Williams[15] advanced the hypothesis that the Welch bacillus was the organism particularly responsible for the toxemia. In support of his theory he cited certain points of similarity between the clinical picture of intestinal obstruction and that of gas bacillus infection, and also the fact that he had found B. welchii in large numbers in the contents of obstructed intestines and in the vomitus from such cases. On the basis of this theory he gave B. welchii antitoxin to two heterogeneous

groups of patients suffering from intestinal obstruction or peritonitis, with an apparently favorable effect upon the course of the disease and with a lowering of the mortality rate.

Bower and Clark[16] reported a series of 25 cases of intestinal obstruction or peritonitis, treated with B. welchii antitoxin. They believed that its administration had favorably influenced the course of the two diseases. Morton[17] also, using a somewhat similar method, considered that the B. welchii was the important organism; this author carried out his experiments on dogs and used simple high obstruction.

McIver et al.[5] were, on the other hand, not able to find sufficient evidence that the B. welchii played an important rôle in the production of the toxemia. The type of obstruction used in their experiments was a closed loop with ligation of its veins; the animal used was the cat. Oughterson and Powers[18] and Thurston[19] also were not able to find sufficient evidence to conclude that the B. welchii was an important factor in the toxemia.

The B. welchii normally found in the intestinal tract are of a rather low degree of virulence. It is obvious that this must be the case, when one considers the large number of instances in which the intestine is drained through an abdominal wound, and the rarity with which gas bacillus infection of the abdominal wound takes place, in spite of the fact that B. welchii may frequently be cultured from the draining wound.* It has also been shown that in intestinal loops under experimental conditions these organisms are usually relatively or entirely avirulent.[5]

It must be borne in mind that in the experimental work the chief method of judging whether or not B. welchii were responsible for the toxemia was to determine whether B. welchii antitoxin was efficacious in prolonging the life of the animals. It is obvious that this method is open to many objections. Furthermore, at best it furnishes evidence as to only

* A generalized infection with B. welchii does occasionally occur.

a relatively small group of anaerobes. Anerobic organisms are without doubt usually present in large numbers in an obstructed loop, where often such good anaerobic conditions exist;[20] so if one is committed to the bacterial theory of the toxemia there seems no good reason against giving the anaerobic organisms a part as well as the aerobic, and the work of Meleney[21] on peritonitis suggests that both types of organisms may play a rôle.

While the question as to whether aerobic or anaerobic organisms are responsible for the toxemia has not been settled, the experiments of Murphy and Brooks,[7] Dragstedt[10] and others furnish evidence that the toxemia in experimentally obstructed loops is due to bacterial action and not to a toxic secretion of the mucosa of the intestine. The question as to how closely these obstructed loops correspond with obstructions encountered in humans has already been discussed.

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ERRATUM

In "This Month's Contributors" in the October issue, Dr. Fowler was erroneously listed as Chief Surgeon instead of Senior Surgeon at the Methodist Episcopal and Wyckoff Heights Hospitals.